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Dams of Masonry and Earth.

The transverse profile of a masonry dam with what is ordinarily called a gravity section has become a matter of exact computation. Indeed, the computations on which are based the dimensions of such a profile are about as precise as those which determine the stresses in a modern steel structure. Given the height of the dam, the maximum head of water to be retained by it, and a satisfactory foundation, and there are few, if any, engineering structures subject to a more clean-cut and well defined treatment than a masonry dam at the present time.

The only source of approximation in the whole process is the neglect of the tensile resistance of the cementing material. The computations are based upon the assumption that the entire mass of masonry is an assemblage of blocks in close contact but without joints having the capacity to resist tension. While this assumption is essential to safety, or rather an opportune safeguard, there are conditions in which it may lead to material errors on the safe side. Even if the best masonry were not subject to the contingency of cracking in setting, changes in temperature, either of a seasonal or diurnal character, would be certain to cause surface cracks at some point. This tendency to show cracks can be much decreased by more thorough and continued wetting during construction than is usually given in the best of masonry work, but it is practically impossible to prevent it all. Much of this cracking is confined to a comparatively small depth near the surface, although there is occasionally an opening extending nearly or all the way through the masonry. In the few cases where there is evidence of the latter, the interior separation of the adjoining masses is exceedingly small and little water ever finds its way through. In fact, a through crack from one exterior face to the other, even in concrete, is not easily found in good work.

The temperature of the masonry obviously may vary much, but that of the interior of the mass can vary but little, even from one season to another, and this is equally true of that portion of the upstream surface which is submerged. Manifestly that portion of the masonry surface being in contact with water must be of about the same temperature as the latter at all times, and this condition restricts the variation of the seasonal limits of the temperature of this part of the structure. As the seasonal variation is much less than that found in those portions of the dam sometimes exposed to the sun's rays and sometimes to the low temperature of winter, temperature cracks must be greatly reduced. Yet these breaks in the continuity of the masonry have become sources of apprehension in the minds of at least some experienced engineers. Obviously these general observations do not apply except to a very limited extent to masonry dams in which light steel reinforcement is used.

The earth dam, either with or without light masonry cores, is a structure of radically different character, as has been brought into prominence by the successful completion of the great earth dykes built by Mr. F. P. Stearns, M. Am. Soc. C.E., for portions of the retaining structures of the Wachusetts reservoir. Their first radically differentiating feature from the masonry dam is the fact that the design of their cross section is not subject to computation; it is a matter of judgment and experience. The mass must be so great that there is no possibility of its being disturbed as a whole by the water which it retains. Again, while it is not necessary that its mass should be absolutely impervious to water, it is fundamentally essential that such water as may percolate through it shall be so small that the granules of earth, so to speak, shall not be disturbed. This means practically that no water shall get through it, although some portions of the upstream part may be saturated and there may be some slight percolation or seepage through the sub-surface foundation mass. At the same time, the consideration of this latter feature brings one to what is perhaps the crucial feature in the stability of an earth dam.

The experience of Mr. Stearns and others who have successfully built earth dams shows that under proper design and construction they may safely be built of almost any height, provided proper material be used and that seepage or percolation through the foundation be prevented, as was so carefully and effectively done at both dykes of the Wachusetts reservoir. Whether the masonry core which Mr. Alphonse Fteley used so satisfactorily in the Croton basin is necessary for the prevention of seepage, may well be doubted, although as a safeguard in comparatively light earth embankments it probably has a valuable function. In any case, however, it does not affect the preceding observations.

It is a question to what extent seepage through the foundation mass may be neglected, if at all. It is clear that any material amount would be a source of danger to the structure. At the same time, it has been maintained that by spreading the base of a comparatively heavy earth embankment, seepage through natural material, such as that which the late Mr. George S. Morison discussed in connection with his proposed Bohio dam on the line of the Panama Canal, may be negligible. This however, has been sharply controverted. It is one of those important questions to which little, if anything, short of actual experience can give a conclusive answer. It is only certain that if no seepage or percolation exists no danger can result from that source, and where great interests are at stake it is unquestionably advisable to eliminate all possible sources of danger. These general questions bear upon interests of great magnitude in connection with both masonry and earth dams. Greater reservoirs than have ever been built are now planned to be constructed which may involve the design of retaining structures of both types, and there are few questions of greater importance at the present time bearing upon any single class of engineering structures.

Some Sources of Waste of Fuel.

The reports of the performance of ordinary electric light and power steam plants continue to show a lack of fuel economy which is somewhat remarkable when compared with the records obtained from steam plants connected with some industries. Electrical engineers attribute this state of things quite properly to the variable character of the load, and have been continually striving to improve the showing. Some formerly thought that thermal storage, which tends to overcome the variable nature of the work in respect to the boilers, had a good chance of producing needed benefits, but this opinion is no longer held. In this they were partly in the right, but largely in the wrong. Much of the waste of coal attributed to variable loads is only an incidental accompaniment of these conditions, and not by any means a necessary consequence. It requires little insight into the practical handling of boilers and engines in electric central stations to understand the real causes which make the coal records so unfavorable.

Every electric light or power station whether large or small is provided with a steam plant which contains a number of engines and a number of boilers. To make the plant flexible and adapt it to the variable load a multiplicity of units seems a necessity, according to most central station managers. The steam plant, or a portion of it, is in operation as a rule night and day during the whole twenty-four hours, and two or more gangs of attendants are employed to take care of it. There are boilers enough under fire and steam to supply the plant when called upon for its maximum output, and a sufficient number of engines are kept warmed and ready for duty to meet the ordinary requirements of the service and any unforeseen emergency caused by change of weather or extra demand. One of the rules of electric light operation is that the power must be "on tap," as it were, whenever it may be called for, and every attendant is imbued with the importance of this idea. Under these circumstances how does the man who shovels the coal and handles the dampers of the boilers, or the man who starts and stops the engines and controls the valves of the station, perform his

duties? If these men follow the natural bent of workmen in their positions, the result will be this:

A greater number of boilers are maintained with live fires than are needed for the moment, and those not required for immediate use are thrown out of active service by opening the fire-doors and closing the ashpit doors, leaving dampers open, and coal on the grates in the active condition of burning. Dependence is here placed on the cooling produced by the inrush of cold air to the furnaces and deadening of the effect of the fires, to prevent too great generation of steam. This practice certainly checks the generation of steam, but it does not stop the consumption of coal. That goes on, though at a reduced rate, the resulting heat being carried off with the air to the chimney. In the same line, the boilers which have banked fires are left with draft on and doors wide open, thereby causing a more rapid combustion of the bed of coal in the bank than would otherwise occur, and, what is worse, cooling down the boiler and its contents through the introduction of the cold air. The loss of heat thus caused must be made good by burning new coal when the boiler is again set to work.

The engineman has a different class of duties. His great object is to have the engines ready in time and keep them in reliable operation. One important foe he has to fight is water in the steam. He must keep the pipes well drained, run the engine long enough when starting without load to insure free pipes and free cylinder; and there is no guide save judgment to show him when this condition is realized. The result is that engines are run a longer time underloaded than the legitimate light load of the station represents, and generally longer than needed for the purpose in view. During the preliminary running drips of steam pipes and cylinders are, as a further precaution, kept wide open, which adds much to the wastefulness of the practice. Furthermore, when the engine is out of use the drips are left open to a greater or less extent so as to keep the pipes drained, and too often the drains of the engines pipes, and of the main system of piping of the boilers as well, are without adequate trap protection. The matter of how the drips are handled is one which is often lost sight of in many kinds of steam plants beside the electric, but it is important everywhere and it provides an avenue of waste which is frequently serious. In the electric plant it is peculiarly liable to be important, owing to the exigencies of the service. The loss from careless handling of drips bears a much larger proportion to the legitimate output when the load is small, as much of the time occurs in electric work, and for this reason waste in electric plants is liable to be extravagant where the matter is neglected. It should not be understood from these statements that the thorough drainage of water from pipes and cylinders is uncalled for. It is in reality one of the most important matters in the care of engines. With the unthinking engineman, however, it may be abused, and it is the abuse of the practice which is the cause of much of the waste in electric stations.

Still another reason exists for the wastefulness of steam plants in electric work. The demands of the service sometimes require a multiplicity of engines. When this is the case the engineers in charge of such plants should keep close watch to prevent the waste of steam through leakage of valves and pistons of the engines, and through disordered stop valves and drip valves in the piping. With these facts in mind it is far from remarkable that the consumption of coal reported by electric plants appears so excessive. If the steam plant in an electric station, or for that matter, in any class of industry, is wasteful, let the work of the individuals who handle the shovel, the assistants in the engine-room, and of the mechanic who makes the repairs, be critically scrutinized, and the cause of large coal bills will not long remain unknown.

Safety Appliances for Excessive Engine Speeds.

The accidents produced by runaway engines remind one that there are times when for some reason or other the governing mechanism of an engine fails to do its work, and the question is raised whether some additional safeguard should not be provided, and thus reduce, if not overcome, the danger of such occurrences. Some people cannot understand why accidents of this nature are not more frequent. Counting the total number of engines in daily operation it will be found that the proportion of them which meet with mishaps due to overspeed is practically insignificant. These facts speak for themselves and protection from accident is already afforded quite satisfactorily. At the same time this element of danger exists, and numerous attempts are being made to provide against it. All sorts of plans are suggested, many devices are already in use, and it is pertinent to inquire what form of device should be provided to serve as such a safeguard if, for any reason, the speed becomes excessive and reaches a dangerous limit.

It has long been the practice in boiler engineering to make the safety valve an entirely independent piece of apparatus, having no connection whatever with any of the devices regularly employed for the purpose. The safety valve is, therefore, generally attached by an independent connection entirely separate from all pipes which convey steam to any other point. The desirability of this practice is almost self-evident, and the same reason should apply in the case of a safeguard for preventing excessive speed of an engine; that is, the apparatus should be wholly independent of the means which are commonly depended upon for the regulation of the speed. Some advantage, perhaps, may be gained by incorporating an attachment with the existing governor, or some portion of the governing apparatus, with the object of making its action more effective in case the speed rises too high. It may be said, however, that if an additional safeguard is to be used at all it should be of such form that it can be relied upon whatever may happen to the governor. For this reason the device to be employed for shutting off the steam should be entirely separate from the mechanism of the engine.

In other words, the safety device should act upon a valve placed in the steam pipe, which should have no duty to perform save the special one under consideration. A number of safety appliances of this nature, wherein an extra throttle valve is placed in the steam pipe close to the engine, acted upon by a regulator which is altogether separate from the main governor, have been introduced. Although these make no provision for reopening the valve when the normal speed has again been recovered, and in this respect do not accomplish so much as might be desired, they have shown that the independent safeguard is not only practicable, but extremely desirable, if an additional safeguard is to be used at all.

Ten Years of the American Portland Cement Industry.

Ten years ago, Mr. William G. Hartranft, in an address at Philadelphia, brought prominently before both builders and contractors a question which was then an important, though old, one regarding the American Portland cement industry. He strongly urged the excellence of at least some of the Portland cements manufactured at this time in this country, and suggested the advisability of immediately supplanting foreign Portland cements by the domestic material. At that time in some cases American Portland cements had been selected by some careful and well-informed engineers after competitive trials with foreign brands and under rigid specifications justly applied. All this was very encouraging and just as every American engineer would wish, but it was generally felt that that while we undoubtedly had raw materials of exactly the right character a sufficient time had not elapsed to yield all the experience which was necessary for the steady production of a perfectly uniform cement of the best grade

Mr. Hartranft pointed out that in the erection of many large buildings, which in the aggregate consume as much Portland cement as some of the important engineering operations, the specifications were so drawn as to exclude the American product. This journal explained that the reason for this was to be found not in an assumption of discrimination against the products of American labor and materials as such, but in the fact that such specifications were drawn by persons not accustomed to test materials in order to ascertain their quality, but who, in an endeavor to secure good work, had specified foreign products which enjoyed a good reputation. The obvious remedy for this state of affairs was the better education regarding the comparative values of American and foreign products, of those who draw the specifications, and a more general introduction of the requirement of tests of materials on building construction. This journal accordingly undertook a comprehensive campaign of publicity concerning the manufacture, testing and use of cement, and the condition of the industry to-day is good proof of the sound grounds for the early faith in American Portland cement.

At that time American Portland cement had been produced which was fully the equal of the best of the foreign product, but even then this journal took the position that the American manufacturer could not be treated more unfortunately by the engineers of this country than to gauge the character of his product by any other criterion than that of intrinsic excellence rather than equality with foreign brands. He had a very high grade of raw material easily accessible, and in many cases in fortunate proportions, but the best results could only be most quickly attained under the stimulus of reasonable requirements as to resistance and endurance. It was evident the time certainly was at hand when in a considerable number of localities in this country Portland cement capable of withstanding the severest duties could be produced at moderate costs. While doubtless much remained to be learned in some cases concerning the proper mixture, burning, and other essential features of successful manufacture, The Engineering Record insisted that the matter of fine grinding needed more attention than it had usually received. Wherever greater fineness of grinding had been attained in an experimental way with a good cement, not only had increased excellence of results been secured, but they had been reached with a less lapse of time. A number of manufacturers opposed this opinion vigorously, some were publicly claiming that fine-grinding was an expensive hobby which would disappear. It is gratifying to observe that fine grinding is now claimed as one of the merits of nearly all brands of American cement on the market, for the additional expense it calls for is definitely proved to be well worth what it costs, and the purchaser is satisfied to pay for it. In fact it would be difficult to sell to-day the coarse cement that was put on the market in large quantities ten years ago. It is not only in fine grinding but in every other respect that the American industry has forged ahead in this brief period, and it is now in the proud position of needing no longer any defense like that made by Mr. Hartranft in 1895.

Overcrowding Chimneys.

There was a plant of boilers in a leading manufacturing city a few years ago which depended for draft on a chimney 100 ft. in height and 6 ft. inside diameter. The area of a cross-section of the flue was 28 sq. ft. in round numbers. The main flue leading to it, which was 6 ft. square, had an area of 36 square feet. There were nine branch flues leading from as many boilers, each 30 in. in diameter, having a collective area of about 44 sq. ft. The boilers were of the horizontal return tubular type, 6 ft. in diameter, 20 ft. in length, and each had 92 3½-in. tubes. The collective area for draft through the tubes was 47 sq. ft. When half the boilers were in operation the force of the draft at the smoke boxes was equivalent to ⅜-in. water pressure. When all the boilers were in action this force was reduced to one-half of that quantity, or 3/16 in. This plant was deficient in capacity, and as there was room in the boiler-house for additional boilers, it was proposed to introduce two new ones, and connect them to the chimney that was in use. It will be seen by the large reduction in the force of draft when all of the present boilers were in use, compared with the available power of the chimney, that the chimney was already overcrowded, and it is doubtful whether the addition of the proposed boilers would in reality have secured the desired increase in the production of steam. It certainly would not result in an increase proportionate to the number of boilers added, for undoubtedly the further addition of boilers would serve to still further reduce the force of draft on all of those then in use.

This is an example of what may be found in a great many of the older steam plants connected with industrial works. They are obliged to depend upon the chimney which was erected when the plant was new, and the demand for more steam due to growth of the business, with the gradual increase in the boiler plant, has crowded the chimney beyond the capacity for which it was at first designed. The question comes, how far can this practice of crowding chimneys be carried and give under working conditions an increased production of steam by an increase in the number of boilers? How to deal with this matter depends somewhat upon the amount of work which the boilers are expected to do and the character of the fuel which is burned, so that the problem is one which must be solved in accordance with local conditions. Some light may be thrown upon the question, however, by further reference to the above example. When the force of the draft was 0.11 in. the evaporation of one of the boilers using Cumberland coal amounted to 4.070 lb. per hour. When the draft was increased to 0.18 in., an increase of 64 per cent., the rate of evaporation rose to 5.415 lb. per hour, an increase of 33 per cent. At this rate a reduction of 50 per cent. in the force of the draft would be accompanied by a reduction in the quantity of steam produced, amounting in round numbers to 25 per cent. The effect of this applied to the nine boilers referred to, in which the force of the draft was only one-half that obtained when five were in use, would be equivalent to the loss of capacity corresponding to at least two boilers. In other words, the plant of nine boilers in this case would do no more work under the reduced draft than seven would do if the full draft of the chimney had been maintained. To put it another way, it is necessary to add two boilers in order to increase the capacity of the plant the equivalent of one. It is not probable that this ratio of increase would continue indefinitely, but these figures are enough to show that the addition of boilers to a plant which is already deficient in chimney power furnishes an unpromising method of obtaining the desired result.

Notes and Comments.

MUNICIPAL OWNERSHIP of the piratical type has received a setback in Meridian, Miss., by a decision of the U. S. Circuit Court for the Southern District of Mississippi. This was rendered in a suit by the Farmers' Loan & Trust Co. against the Meridian Waterworks Co. and the city of Meridian for the appointment of a receiver for the company, whose property was threatened with serious damage by the city. The court rules that a franchise granted to a water company to maintain pipes in the streets of a city to supply water for a term of years constitutes a contract, which is protected from impairment by the Constitution of the United States. Such a grant also creates an easement which may be mortgaged, and the mortgagee cannot be deprived of such security by a decree against the company annulling the franchise, entered in a suit begun after the mortgage was given and to which the mortgagee was not a party.

A NOVEL USE OF DERRICKS has been adopted by the Cranford Paving Co. in laying asphalt on the new highway bridge across the Potomac at Washington. The asphalt plant is in Washington and the hot paving mixture was readily hauled to the north half of the bridge. The strike of the iron workers delayed the completion of the draw span of the bridge and it was impossible to haul the hot asphalt over it to the southern part of the bridge. As the time clause in the paving contract was very strict, and the hauling of the asphalt over the Long bridge to the Virginia shore and then around to the new bridge would have taken enough time to permit the material to cool off, some other method had to be found. This was barging the carts across the river to the Virginia spans, where a strong derrick was placed. With the derrick the carts were lifted to the bridge deck, where teams were waiting to haul them to the place where the material was needed.

A WATERPROOFING OPERATION that attracted some attention in Great Britain when it was performed was the lining of some old filters of the Warrington water works. They were formed with clay puddle bottoms and sides, the latter being faced with brick on edge. Watertightness was secured by using Callender's bitumen sheeting, this material being selected as well adapted to bear the slight periodical movements of the banks due to the varying amount of moisture in the clay. A thin layer of fine concrete was first spread on the bottom and carefully smoothed over. The bitumen sheeting was laid on this and covered with 5 in. of fine concrete, with a finishing coat of cement mortar. The sides were paved with pressed brick. Considerable difficulty was experienced in laying the bitumen sheeting owing to the pressure of the ground water during wet weather. Holes had to be cut in the sheeting to relieve this. The holes were afterward made good and the paving completed after the brickwork had set.

A FEATURE OF MUNICIPAL OWNERSHIP which has been apparent for many years, the unwillingness of public officials to charge up all fixed expenses against public plants, is emphasized in some recent proceedings before the Massachusetts Gas and Electric Commission. Three years ago the city of Haverhill bought the local gas and electric plant for $829,252.21 and has since spent $267,722.94 on it for additions and improvements, a total of $1,096,975.15, mostly raised by the sale of 3½ per cent. bonds. The estimated expenses for 1906 are: operation, $230,871; interest, $28,185; retiring bonds, $36,600; depreciation at 5 per cent., $54,849, total of $350,415. The estimated income is $228,000, leaving $122,415 to be raised by taxation. If from this total deficit the $36,600 for bond payments is deducted there remains $85,815 to be raised by general taxation to meet the running expenses of the works. The city asked the Commission to relieve it of this obligation, claiming that it was unnecessary and unreasonable in the case of public ownership. The Commission has unanimously declined, refusing to see in municipal ownership any special grace or financial license absolving the authorities from the exercise of business principles.

THE PURIFICATION OF FEED WATER before its supply to stationary boilers is a thing too little thought of in the design and operation of steam plants. In some favored localities the water is pure enough, and with almost no special care the heating surfaces can be maintained indefinitely in the clean condition of new work. Of most places, however, this cannot be said. In the great majority of boilers, the heating surfaces are covered to a greater or less extent with a layer of scale, its character and thickness depending upon the character of the water and the frequency with which the boilers are overhauled and cleaned. It seems a wrong principle to force upon a steam boiler any other duty than that of making steam. That it should serve as a device for removing impurities from the water, when these stand in the way of securing high efficiency, is contrary to sound engineering principles. The incongruity of trying to combine the duties of a steam boiler and a feed-water purifier in the same apparatus is strikingly realized by every engineer who has charge of boilers located in limestone regions. As an example in point, most boilers in the valleys of the Lehigh and Monongahela Rivers, in Pennsylvania, deposit scale with great rapidity. At intervals of not more than six months they must be shut down for a periodical cleaning. Scale has formed at the end of that time to a thickness varying from one-eighth to three-quarters of an inch, and it is no small task to remove it. In the case of many water-tube boilers it must be drilled out with the help of blows from a heavy hammer, and several cutting tools of increasing sizes must be brought into use, one after another, before a tube is thoroughly cleaned. The labor involved in doing this work is a considerable item, to say nothing of the continued loss of fuel sustained by the boiler with scale-covered surfaces, which at the very best are never perfectly clean.

It is quite practical to purify water of most, if not all, scale-forming material, and introduce it into the boiler in a pure state. Mud and impurities held in mechanical suspension can be removed by settling and filtering. Salts of lime held in solution, which form the largest proportion of scale ingredients usually met, can be thrown down by preliminary heating. The carbonates require a comparatively low temperature for the precipitation. A suitably arranged open exhaust-steam heater, provided with depositing plates, collects most of these substances and intercepts them on their way to the boiler. Farther heating to the working temperature of the boiler by means of live steam, if done in a separate chamber, precipitates most of the remaining elements held in solution, which would otherwise be thrown down on the heating surfaces of the boiler. The sediment thus separated by means of devices outside of, and independent of, the boiler, can be got rid of without difficulty, and the boiler can be employed in its legitimate work of making steam. There seems to be so much common sense in purifying feed water before it goes to the boiler, if it needs purifying at all, that it may be thought unnecessary to call attention to the subject in an engineering journal. Nevertheless, it is one of the things which, upon some engineers and many owners and builders of steam plants, makes the least impression.

THE SEWAGE PURIFICATION WORKS AT COLUMBUS, OHIO.

By Julian Griggs, Chief Engineer, Board of Public Service, Columbus.

In The Engineering Record of November 19, 1904, a brief description was given of the sewage testing station which the City of Columbus, Ohio, had installed for carrying on a series of extended experiments on a practical scale for a period of one year, in order to ascertain the most efficient and economical method of purifying the dry-weather sewage flow of the city before discharging it into the Scioto River.

The investigations at the testing station were commenced in August, 1904, and were carried on continuously until July, 1905. It is not the purpose of the present article, however, to discuss the results of these investigations, as a full report of them will be printed at a later date, but to describe briefly the purification works which the city is to build as the result of these investigations, bids for which were received on November 2.

In the article above referred to, the steps which had been taken toward the construction of purification works, previous to the installation of the testing station, were briefly reviewed, and it may not be amiss to state again that in 1898 Mr. John W. Alvord and the writer presented a joint report in which they recommended double filtration through coke breeze filters. No immediate action having been taken after the submission of this report, Mr. Rudolph Hering was asked to review the whole subject and in 1901 reported in favor of septic tanks followed by intermittent filtration through sand, with the additional recommendation that only a part of the plant be constructed at first, and that it be operated for a period of at least one year for the purpose of determining the most efficient and economical arrangement of the remaining part of the plant.

The purification of the Columbus sewage by preliminary classification and subsequent intermittent filtration through sand was fully investigated at the testing station with satisfactory results as compared with experiences elsewhere. However, the tests showed for the first time in this country that sprinkling filters could be satisfactorily operated in this northern climate, and produce a satisfactory effluent at less cost than by any other type of filter. The method adopted comprises septic tanks, sprinkling filters and settling basins.

The purification works will be located in Franklin Township, on the west bank of the Scioto River about three and one-half miles south of the City Hall. In order to make available this natural location, changes in and extensions of the present sewerage system have been required, but it will suffice to say that by separate sewers and by combined sewers discharging into intercepting sewers, the dry-weather flow will be collected at a point about two and one-quarter miles south of the City Hall from which point it will be pumped to the purification works. The storm water sewers, and the storm water flow in the combined sewers in excess of that intercepted, will be discharged direct into the river.

The general mode of operation at the works may be briefly described as follows: The sewage from the force main will be discharged into the upper end of the septic tanks, through which it will flow at a low velocity. From the septic tanks the partially purified sewage will be delivered into a gate house from which point it will be discharged to the sprinkling filters. The effluent from the filters will be collected and returned to the gate house and will then pass into the settling basins. The clarified effluent will be drawn off from the settling basins and discharged into the river.

The purification works to be installed at present will have a nominal capacity of 20,000,000 gal. per 24 hours. The pipe lines, conduits and controlling devices have, however, been so designed, that without any changes the works can be extended at any time in the future to a capacity of 30,000,000 gal. per 24 hours. The general plan of the works is shown in one of the accompanying drawings.

The septic tanks will be six in number, four of which may be called primary tanks, into which the sewage will be first discharged, and the other two, secondary tanks, from which the septic effluent will be drawn off. The tanks are all to be uncovered and will have a mean depth to normal high water line of approximately 12 ft. Each of the primary tanks will be 56 ft. 6 in. wide by 150 ft. long on the neat lines. The secondary tanks will each be 115 ft. 6 in. wide and 262 ft. long on the neat lines. Each secondary tank will be divided crosswise into two compartments by a baffle wall about 8 ft. high.

The four primary tanks are to have a total capacity of 2,840,000 gal. and the two secondary tanks a total capacity of 5,180,000 gal. The total capacity of all six tanks combined will be 8,020,000 gal.

By means of a conduit extending the full length of the north wall and built as a part of the wall, the sewage can be discharged through sluice gates into any or all of the primary tanks. The sewage can be drawn off from any or all of the primary tanks into the collecting and distributing wall between the primary and secondary tanks, and discharged into either or both of the secondary tanks. The collecting and distributing wall will be built as a hollow wall with three channels in it, one above another, the upper channel being an overflow, the middle one the collecting and distributing channel and the lower one the blow-off leading to the river. At the south wall the septic effluent will be drawn off over a baffle and collected through openings into a conduit extending the full length of this wall and built as a part of it. The north and south walls are similar in construction.

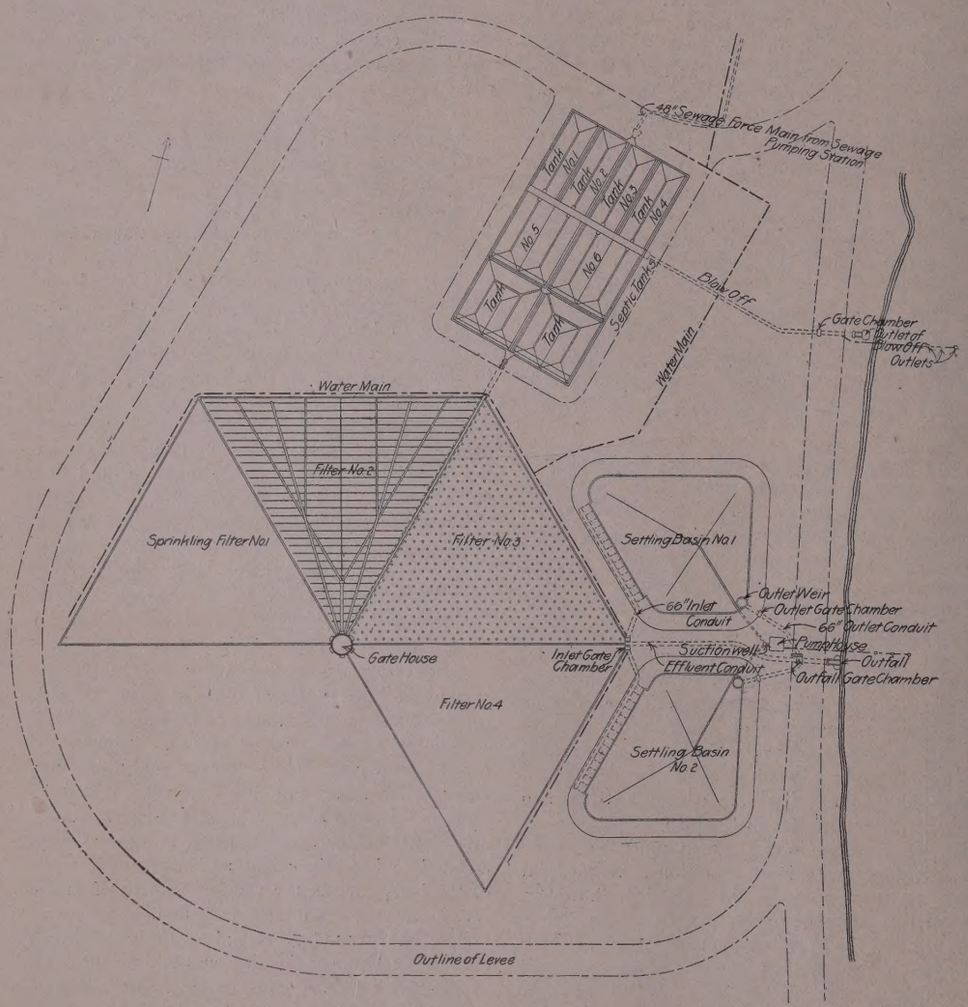
In the operation of the tanks it is intended to draw off the septic effluent at a constant rate during the 24 hours, the rate being such that the total amount drawn off will equal as nearly as possible the total amount pumped in. The flow from the tanks will be controlled by two adjustable controllers located in the central gate house.

In order to maintain a constant rate of discharge at the outlet with a variable supply at the inlet, it will be necessary to allow the surface level in the tanks to fluctuate. With a constant discharge of 20,000,000 gal. per 24 hours, and with the mean hourly variation in dry weather flow as determined for Columbus, the depth in the tanks will vary from a minimum of about 8.9 ft. to a maximum of 12 ft., or a total fluctuation of about 3.1 ft. On the above basis the average period of flow through the tanks with all in use will be about 8½ hours.

The tanks will be built entirely of concrete with expansion joints inserted at intervals in all the walls. Gravity sections have been used for the walls except where the type of construction requires a different treatment.

In front of the baffle wall in the secondary tanks and also in front of the south wall into which the septic effluent will be drawn off, scum boards are to be provided, extending the full width of the tanks. These will be constructed of cypress, rigidly fastened to arms hinged at the walls, so as to allow a rise and fall with the fluctuating level.

In each of the primary tanks a sludge drain



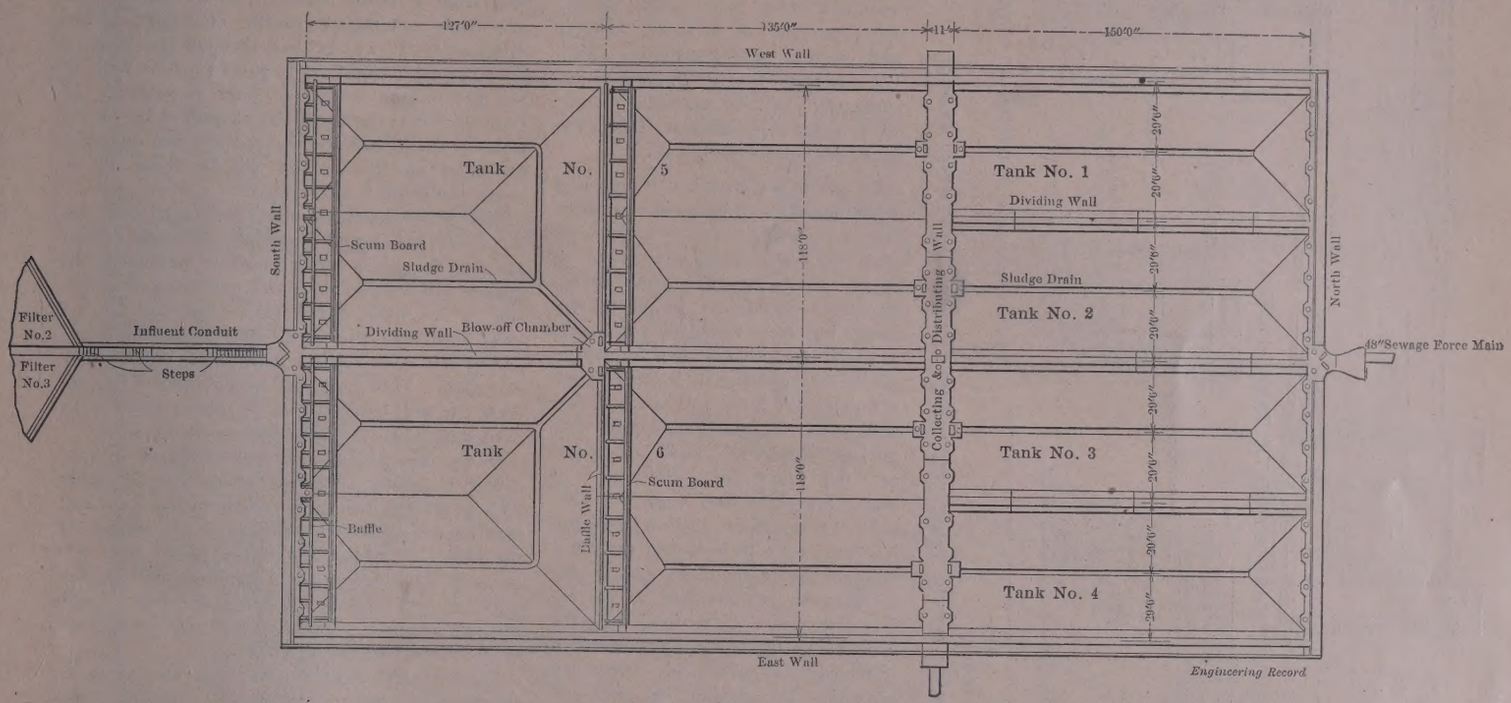
General Plan of Sewage Treatment Works.

will extend up the center and nearly the full length of the tank. The outlet will be at the collecting and distributing wall and into the lower or blow-off channel in the wall. In the up-stream compartment of each of the secondary tanks two sludge drains will be provided with their outlets also at the collecting and distributing wall. The sludge drains will also be provided in each of the down-stream compartments of the secondary tanks, their outlets, however, being at a blow-off chamber both of the secondary tanks. Also any one of the primary tanks and either compartment of either of the secondary tanks can be drained independently.

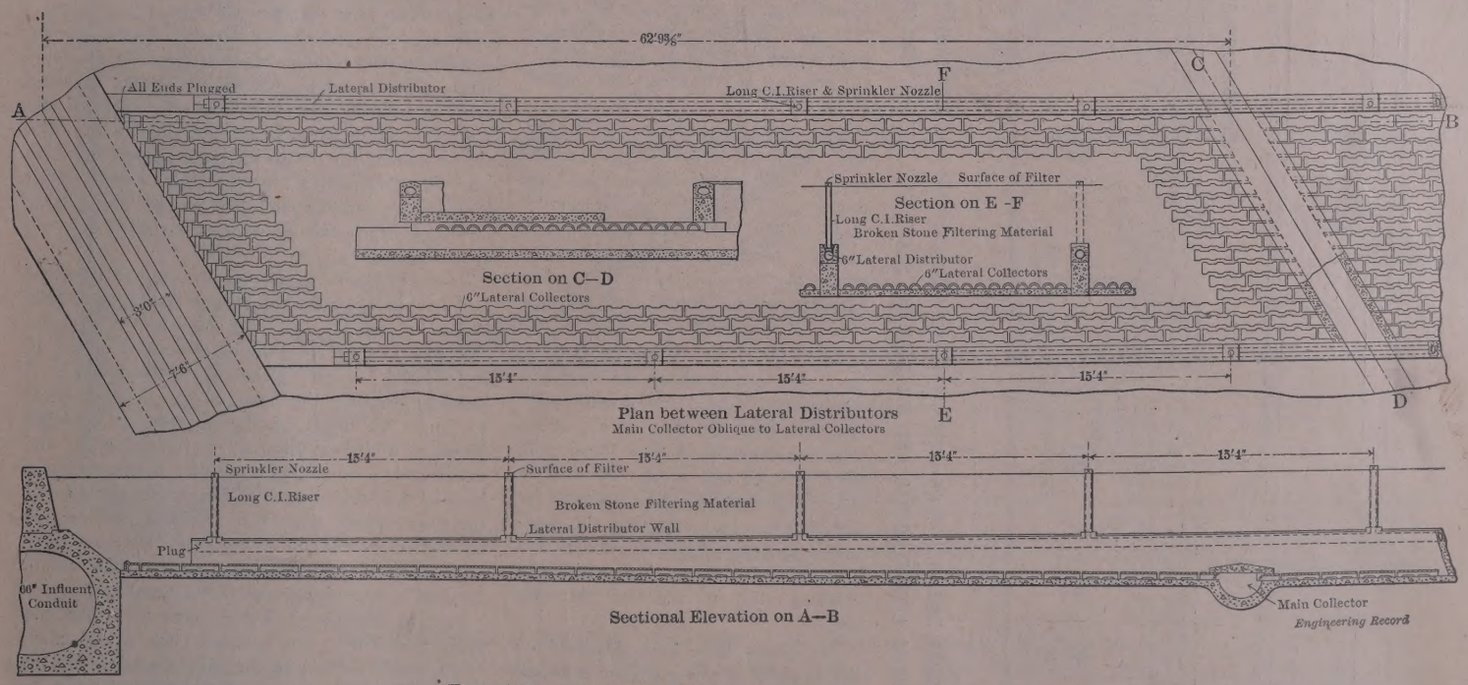
From the easterly end of the collecting and distributing wall a 40-in. by 60-in. egg-shaped blow-off will extend to a gate chamber located near the river just inside the levee. This chamber will have two outlets to the river, one, 48 in. in diameter, terminating at the bank and protected let will be open and the 16-in. closed.

The septic effluent having been drawn off at the south wall of the tanks will flow to the effluent well in the substructure of the gate house through a 66-in. reinforced concrete conduit, for convenience called the influent conduit, and located under the dividing wall between Filters Nos. 2 and 3.

The gate house will be circular in plan, 38 ft. in diameter outside. In the substructure, built of reinforced concrete, will be located the various wells



General Plan of Septic Tanks, Columbus Sewage Treatment Works.



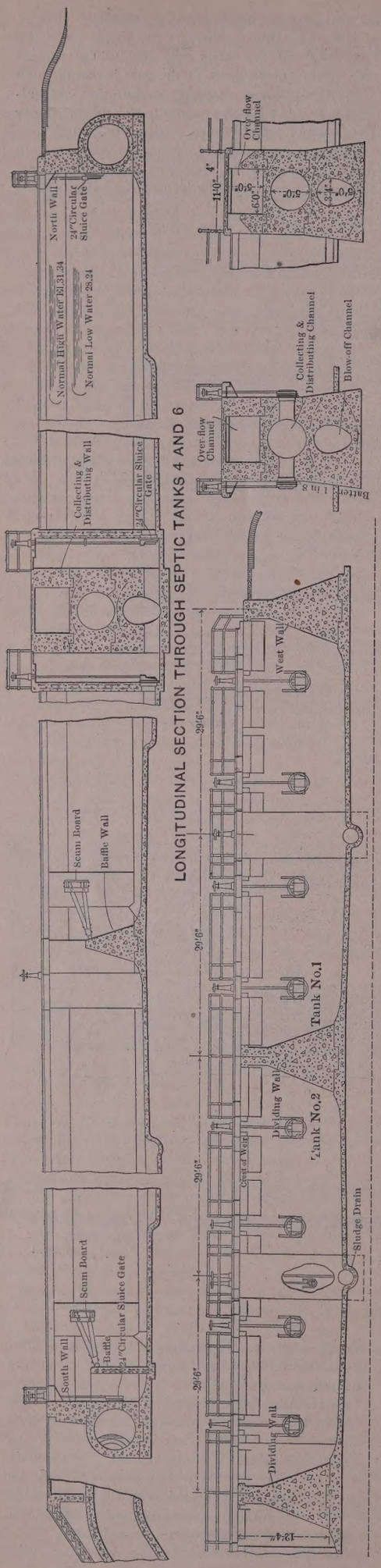
Typical Construction of Sprinkling Filters, Columbus, Ohio.

located at the intersection of the baffle walls with the dividing wall between the two secondary tanks. From this chamber a 24-in. by 36-in. egg-shaped drain will extend under the dividing wall between the two tanks, to the blow-off drain in the collecting and distributing wall.

From the description of the septic tanks already given it will be seen that a very flexible arrangement has been provided to meet the varying conditions which are likely to arise in the operation of the works. Briefly stated, any or all of the primary tanks can be operated with either or with a 48-in. flap valve, the other, 16 in. in diameter, extending to the middle of the river and having three outlets just above the river bed. These three outlets will be 8-in., 10-in. and 12-in., respectively, in diameter and each furnished with a flap valve. The 48-in. line has been provided as an outlet in case of overflow at the tanks, and the 16-in. line for the purpose of draining the tanks if necessary. By means of sluice gates placed in the gate chamber the 48-in. line can be shut off when the 16-in. line is in use. Except when the tanks are being drained, however, the 48-in. out- and chambers for controlling the discharge from the septic tanks, and the flow to and from the sprinkling filters.

The influent well, located in the center of the substructure, 15 ft. in diameter and about 25 ft. 3 in. deep, will contain two controller wells approximately elliptical in plan, each 6 ft. 6 in. wide by 7 ft. long. In each controller well will be placed a specially designed controller, adjustable from a minimum discharge of 10,000,000 gal. to a maximum of 22,500,000 gal. per 24 hours.

The flow of the effluent from the septic tanks



will be regulated by the controllers, and will be from the influent well through the controller wells and controllers into the distributing well, this latter being an annular well 3 ft. wide around the influent well. From the distributing well the septic effluent will pass into small chambers connecting with the distributing systems of the sprinkling filters, these chambers being subdivisions of the upper portion of an outer annular well around the distributing well. The lower portion of this outer annular well will be the effluent well into which the effluent from the sprinkling filters will flow.

As previously stated, it is intended in the operation of the works to maintain a constant rate of discharge from the septic tanks during the 24 hours. The controllers would be set as nearly as possible to secure this result, but as it would be impossible to predict exactly the flow for the 24 hours, the condition is liable to arise of having the tanks fill up to normal high water line and of having the rate of supply into the tanks in excess of the rate of discharge at which the controllers were set. To meet this condition, instead of allowing this excess to pass over the overflow of the septic tanks and thence to the river, an overflow on the influent well at a lower level than the overflow of the septic tanks has been provided, over which this excess can pass into the distributing well and out to the sprinkling filters. The overflow of the septic tanks will come into play only in case of excessive high water in the tanks and then only to prevent overflowing the outside walls.

The sprinkling filters, of which four will be built in the present works, will radiate from the gate house, each being an equilateral triangle in plan. With the construction of two additional filters, space for which has been provided, a complete hexagon will be formed with the gate house at the center.

Each filter will be 505 ft. 1¼ in. on a side, measured on the neat line of the outer side of the outside wall, and will have an area of 2.5 acres. The total area of all four filters will, therefore, be ten acres. Each filter will be divided by the systems for distributing and collecting the sewage, into two units, each having an area of 1.25 acres, but without a dividing wall to separate the two units.

The filters have been designed on the basis of a net yield of 2,000,000 gal. per acre per 24 hours when resting one-half of the time. When in service, however, the rate of filtration under normal conditions will be 4,000,000 gal. per acre per 24 hours.

The floors and walls of the filters are to be built of concrete. The filtering material will be of a hard broken stone, averaging about 5 ft. 4 in. in depth above the floor. The lower to 10 in. will be from 2½ in. to 4 in. in size and the remainder from ½ in. to 2 in. in size.

Each unit of each filter can be operated independently of the other unit. The distributing system of each unit will consist of a main distributor feeding into lateral distributors, which in turn feed into vertical risers. On the upper ends of the risers sprinkler nozzles will be placed which will spray the sewage on to the surface of the filter.

The main distributor will be built of reinforced concrete 30 in. in diameter extending in a radial line from a small chamber in the gate house, previously mentioned, to the outermost lateral distributor. It will be laid through the body of the filter on a slight grade so as to drain back to the gate house when the filter is resting. At frequent intervals it will be supported by extensions of the lateral distributor walls and the highest point on the outside will be about 14 in. below the surface of the filter.

The lateral distributors will consist of 5-in. and 6-in. vitirified sewer pipe laid in straight lines about 13 ft. 3⅜ in. center to center, parallel to the outside wall of the filter, and extending on either side of the main distributor. They will be laid level with their inverts all in a horizontal plane and a few inches above the invert of the main distributor. The pipes will be surrounded by concrete and will be supported on thin concrete walls extending down through the floor of the filter.

In the lateral distributors at points 15 ft. 4 in. center to center, vitirified sewer pipe branches will be placed, and from each branch a 3-in. cast iron riser will extend vertically to the surface of the filter. The joint at the base of the riser will be made with lead and into the upper end of each riser will be screwed a brass sprinkler nozzle through which the septic effluent will be sprayed on to the surface of the filter.

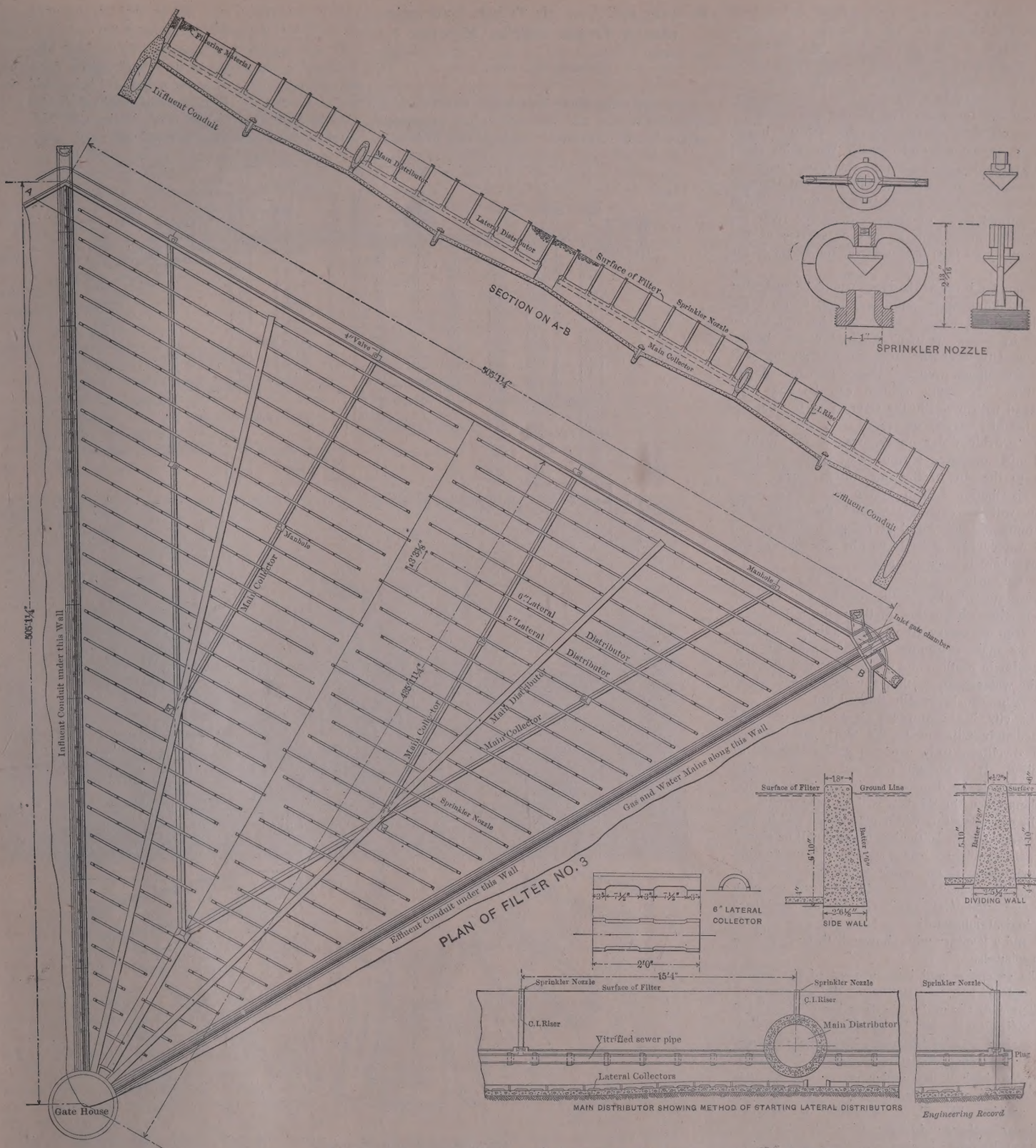
Considerable thought and study was given to the design of the nozzle, and an extended series of experiments made to determine the proper proportions after the general type proposed had been adopted. It is an extremely simple device, consisting of a single orifice 9/16 in. in diameter with rounded edges, above which an inverted cone is held by two thin arms, the axis of the cone coinciding with the axis of the orifice. The jet on leaving the orifice impinges against the cone and is transformed into a thin sheet which spreads out radially and then breaks into a mass of drops which fall on an area included between two concentric circles.

With the filters operating at a rate of 4,000,000 gal. per acre per 24 hours each nozzle must discharge about 13.1 gal. per minute. When discharging 13.5 gal. per minute a head of only 5 ft. is required. In the operation of the filters it is intended to vary the head on the nozzles, so as to cover as much of the surface as possible. From a minimum head of 2 ft. and 9 in. and discharge of 10 gal. per minute, to a maximum head of 5 ft. and discharge of 13.5 gal. per minute, the experiments show that, without making any allowance for the aid of the wind, at least 77 per cent. of the area tributary to each nozzle will be covered in a perfectly satisfactory manner.

At first thought it would seem as if the two arms which hold the inverted cone would cause serious obstructions to the thin sheet leaving the cone. The arms are, however, ground down to sharp edges in a vertical radial plane and the sheet after passing heals up entirely so that trouble from these obstructions is eliminated.

The nozzle has many good points to commend it, among which may be mentioned, extreme simplicity, minimum head required, satisfactory spray, large percentage of area covered, absolute freedom from clogging and low cost.

By allowing less fluctuation in surface level in the septic tanks a greater head can be made available at the nozzle, the maximum being about 8 ft. Additional area can be covered by making



Plan and Details of One of the Filter Beds of the Columbus Sewage Treatment Works.

use of the greater head, but at such times the discharge would be greater and a slight overlapping of the spray from adjacent nozzles would take place. Under careful management, however, it would be perfectly possible to operate thus for short periods of time with satisfactory results.

For collecting the effluent from the filters, a very free draining bottom will be provided. This will consist of 6-in. lateral collectors made of spigot and vitrified channel pipe, notched on both edges. The lateral collectors will be laid in straight parallel lines on the floors of the filters with a space of ¾ of an inch between them longitudinally. The laying of the lateral collectors will follow closely the laying of the concrete floor, and the collectors will be firmly bedded on their edges before the concrete has obtained its initial set.

The floors of the filters will be sloped from the dividing walls and also from intermediate ridges to main collectors into which the effluent from the lateral collectors will be discharged. The main collectors, which will be below the floors of the filters, are to be built of concrete and covered with reinforced concrete slabs.

The main collectors from the two units of a filter will discharge into a common sump just outside the gate house. From the sump the effluent will pass into the effluent well, previously mentioned in the description of the gate house.

From the effluent well a 66-in. effluent conduit built of reinforced concrete will extend under the wall between Filters Nos. 3 and 4 to the inlet gate chamber of the settling basins where it will branch into two 66-in. concrete inlet conduits. The effluent from the sprinkling filters will pass through the effluent and inlet conduits and out through 21-in. vitrified sewer pipes into the settling basins.

Two settling basins will be built, each having a capacity of 2,000,000 gal. They will be from 4 to 4½ ft. deep, and the normal surface level will be 5 ft. above mean low water in the river. The basins can be operated independently of each other if desired.

A concrete floor 4 in. thick will be laid in each basin, and around the foot of the slope a concrete toe wall 12 in. high will be built. As the basins will be all in excavation and the material a coarse gravel, no paving will be laid. The banks are to be excavated to a slope of 3 to 1 and the portions above the water line loamed and seeded.

The clarified effluent from the settling basins will be drawn off under easily removable sheet steel scum boards in a thin sheet over circular weirs. From the weirs it will pass out through the by-pass to the river as just mentioned. With an additional rise of about 2 ft. in the river the sprinkling filters will go out of service as the effluent would then back up over the floors of the filters.

When the level of the river would be such that the sprinkling filters could no longer be used, the septic effluent can, however, still be run to the river by means of by-passes in the gate house, arranged to discharge from the distributing well into the effluent well and thence into the effluent conduit. The septic effluent can be thus discharged with a rise in the river of 19 ft., that being the highest rise on record.

To provide water under pressure for flushing and other purposes, a 10-in. water main has been run to the site of the purification works from the distribution system in the city. This water main will be extended around the works and hydrants will be placed at frequent intervals, so that water under pressure will be accessible at any point where it may be needed.

In the sprinkling filters, in order to maintain a uniform distribution at the nozzles and to keep the frictional losses low in the main collectors it has been necessary to use depositing velocities. On the main collectors, manholes will be provided for inspection, and connections will be made to the water main so that any depositions which may occur can be readily flushed out.

The city has acquired a large tract of land immediately adjacent to the works and remote from dwellings, to be used for sludge disposal as required. It is thought that some of the sludge can probably be disposed of in the river during freshets when the dilution will be very great.

The superstructure of the gate house will be two stories in height. In the lower story will be placed the gate stands and other devices for controlling the operation of the septic tanks and sprinkling filters. The second story will be fitted up with an office, completely equipped chemical and bacteriological laboratories, a room for the attendants and a lavatory with shower bath and sanitary conveniences.

The extension and improvement of the sewerage systems and construction of the sewage purification works is under the direction of the Board of Public Service, Mr. Hiram O. Pond, President. The writer is Chief Engineer, Mr. John H. Gregory is Principal Assistant Engineer in general charge of both design and construction, and has prepared the concise descriptions of the work for this article. Mr. E. A. Kemmler is Resident Engineer in charge of construction, Mr. George A. Johnson, Engineer in charge of the testing station, and Messrs. Rudolph Hering and Geo. W. Fuller are Consulting Engineers.

A HEATING COIL CONNECTION to an exhaust steam line, made without introducing back pressure, is described by Mr. A. J. Schneider in "The Engineer." It consists of connecting the radiator or heating coil supply into the upper side of the exhaust pipe and the return or drip connection to the lower side of the exhaust, so that condensation will accumulate and form a water seal. This seal permits the condensation to overflow into the exhaust line gradually as it accumulates. There should be an air cock on the heating coils at the drop connection for removal of air.

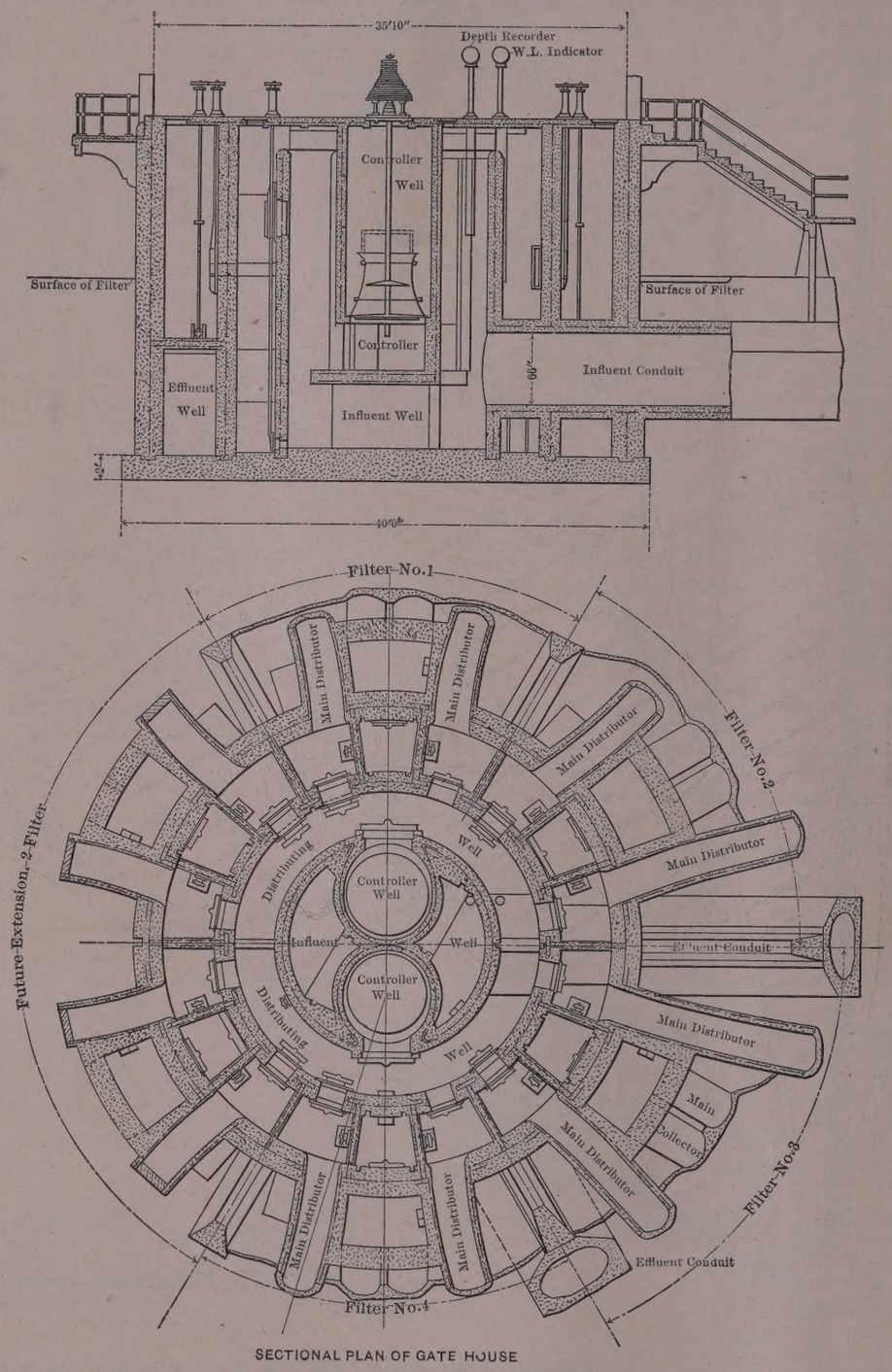
Methods and Cost of Trench Excavation with a Trench Digging Machine.

By Halbert P. Gillette, M. Am. Soc. C. E., Consulting Engineer, New York.

One commonly hears it said that no method of earth excavation can compare in low cost with excavation by hydraulic dredges and hydraulic giants. In fact, I made this statement myself several times. I purpose giving some cost data relating to excavating trenches with a machine, from which it can be seen that earth can be loosened and moved at a cost that compares favorably with dredging and hydraulicing. To me the astonishing feature of the facts that I shall give is the comparatively low first cost of the machine that does the work. The great hydraulic dredges used on the Mississippi and elsewhere are excavators of remarkable efficiency, but they are also remarkably expensive in first cost. Moreover they are limited to certain kinds of soils and certain conditions to a degree that the common steam shovel in the dipper dredge is not.

It was my good fortune recently to visit Milwaukee, or rather one of its suburbs, West Allis, where many miles of water mains are being laid under contract by the American Light & Water Co., as contractors. The earth is the stiff Milwaukee clay, in spots rendered soft and sticky by springs or natural drainage channels; but, for the most part, very tough digging. I was informed that if a laborer could pick and shovel 7 cu. yd. out of a shallow trench in 10 hr., he was considered a good workman; and my own observation of the handwork being done in places confirmed this statement.

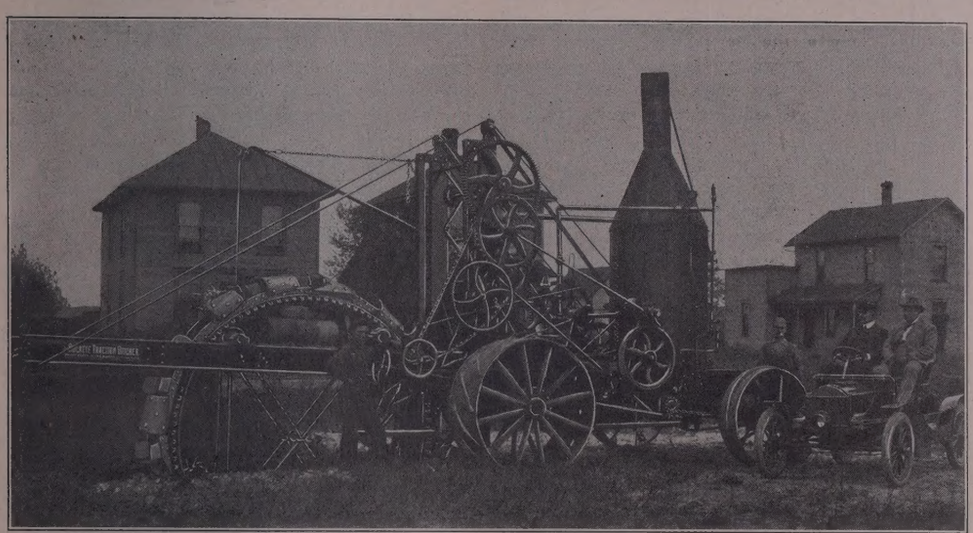
Under the specifications a trench 7 ft. deep is dug for all water pipes of sizes up to 12 in., presumably to insure being well below the frost line of the severest winter. The contractor for this work has been using a trench excavating machine, and, at the time of my arrival, was



Sectional Plan and Elevation of the Gate House of Columbus Filter Beds.

installing another one of the same size and type. The machine has been described briefly in this journal, but a brief statement of the main features, its design, and a photograph of the machine itself will assist in a better understanding of the reasons for the low cost of the work performed. The trade name of the machine, I should have said, is the Buckeye traction ditcher, and it is manufactured by the Van Buren, Heck & Marvin Co., of Findlay, Ohio.

The machine consists essentially of a large wheel, to the periphery of which are fastened the digging buckets. The wheel has no axle, but is supported by four pairs of rollers inside its periphery. The wheel is supported between I-beams projecting from the rear of the trucks. These I-beams can be quickly raised or lowered by the operator, so that the bottom of the wheel can cut to the exact depth and grade desired. By sighting along range poles stuck in the ground ahead of the machine, the operator can not only keep on line with his trench, but he can keep the bottom of the trench exactly to grade. The machine is self-propelling, and moves steadily forward, leaving the completed trench behind. In digging a trench 26 in. wide by 7 ft. deep in tough clay, the ditcher was geared to travel at a speed of 2 ft. per minute. If kept up without interruption for 10 hours, this would mean 1,200 lin. ft. of trench. Of course there are usually some delays that cut down the day's output, of which I will speak later.



View of Traction Ditching Machine Digging a Sewer Trench.

When I came upon the machine at work, I stood fascinated. It seemed scarcely to be moving forward, yet the stream of finely chopped clay falling on the bank from the endless belt conveyor enabled one to appreciate how fast it was eating its way ahead. I had read of trench excavators and had seen photographs of them, but up to that moment I must admit that I considered them rather as an inventor's dream than as a practical tool for contractors. I now think that while improvements will undoubtedly be made, the experimental stage of development, at least of the machine I saw, is passed. Evidently the contractors using the machine have reached a similar conclusion, and I would put more trust in their judgment than in my own, since they now have four machines at work in different parts of the country, the three having been bought after a thorough trial of the first one. Few contractors like to trust their own judgment in buying a class of machine which they have not previously used or seen in use; and, after all, that is the safest procedure. The main danger of this plan, however, lies in deferring too long the purchase of a money-making device. There is the additional danger that the contractor will buy the first machine that comes with a good recommendation, without waiting to investigate others which may prove even better.

Now, as to the cost of operation and the average daily output under the conditions above given. It takes three men to run this machine; an operator, a fireman, and a rigger or oiler. In addition to this, add half the wages of a blacksmith; for a blacksmith (without a helper) sharpens the 42 teeth of the buckets and the 13 side cutters in 1½ to 2 days. This sharpening must be done once a week when working in tough clay. One blacksmith readily takes care of two machines. The 24-h.-p. engines that run the machine average 1,500 lb. of coal per 10 hours of steady work. The water is hauled in a tank; and, as one of the teams engaged in backfilling is used for hauling the water at intervals, there is really no appreciable charge for water. If the water haul were long, its cost could be estimated by allowing a gallon of water for each pound of coal.

When the machine is digging on the side of a street having a very sharp crown, it is necessary to lay blocking for the wheels on the lower side to run on. This must be done in order to keep the whole machine level and insure securing a trench with sides that are plumb. In dry, tough soils it is often not essential that the sides of the trench be plumb, but in wet soils, or wherever the ground caves readily, even a slight overhang of either side of the trench causes caving. It is astonishing how little the overhang need be to cause caving in a treacherous soil. Of course bracing can be placed just as fast as the machine moves ahead, but even the five minutes that the trench remains unbraced may cause a slide of earth in treacherous ground; this, while it does not stall this machine, makes extra work.

Reverting to the subject of placing blocking, I found two men engaged in this work, using for the purpose old 3-in. plank and short 8x8-in. sticks. The machine is advancing 2 ft. per minute, which gives plenty of time for the two men to bring up the blocking from behind and lay it in front of the wheels. The street on which they were working was more like a country road than a street, as it had an exceedingly sharp crown. On most streets one man attending to the blocking is sufficient, and where the crown is comparatively flat, no man is needed for this purpose at all.

As to the daily output, I have already said that 1,200 lin. ft. of trench 26 in. wide by 7 ft. could be dug in this tough ground in 10 hours under perfect management, and with a skilled operator. This would mean nearly 700 cu. yds. per day; and I have seen the machine working at this rate. But with an operator of short experience, a fair day's work was 700 lin. ft., and a good day's work was 900 lin. ft. I would put the average at the latter figure for a skilled man, and it pays to employ no other kind. I should secure an intelligent man experienced in running a steam shovel, and should not want a man who could command less than $5 a day elsewhere. I would pay him that much and a bonus for every foot of trench over, say, 900 ft. cut per day. The following is my estimate of the cost of operating a trench-digging machine of this size and type: 1 operator, per day, $5; 1 fireman, per day, $2.50; 1 oiler, per day, $2.50; 1 laborer, blocking, per day, $1.75; ½ blacksmith, at $2.50 per day, $1.25; 1,500 lb. coal, at $4, $3; total per day, $17.

With 900 ft. of trench 7 ft. deep as a day's work, the cost of excavating is less than 2 ct. per linear foot, or less than 3½ ct. per cubic yard. Note that the wages are liberal and the price of fuel is high. I have not included the cost of oil, but, like the cost of water, it is so slight as scarcely to warrant consideration in making an estimate of this kind.

When the statement is made that ground can be excavated for 3½ ct. per cubic yard, one naturally compares the cost with steam shovel work, which is ordinarily much more expensive than this. It should be remembered, however, that a steam shovel is necessarily idle for a large part of the working day. There is time lost in shifting the shovel forward. There is time lost in waiting for cars, and in various other ways, which taken in the aggregate amount to several hours daily, even under good management. Usually six pit men are required to shift and lay track for the shovel, beside the three men on the shovel. And on top of all this expense is the cost of hauling the earth away, the cost of laying track, repairing cars, etc. When these items are considered, one is willing to concede the possibility of excavating a trench for 3½ ct. per cubic yard with a machine that moves continuously forward depositing the spoil on the bank automatically.

Now, as to the charge for interest and depreciation of plant. I am unable to give more than an estimate in this case, but, knowing the first cost of the machine, it should not be difficult to approximate this item. A Buckeye traction ditcher of a size that will dig a trench 7½ ft. deep and 2 ft. wide, may be bought for $4,600. Allowing 6 per cent. for interest, we have an annual charge of $276. The cost of maintenance should not exceed the cost of maintaining a 40-ton steam shovel, and, as a matter of fact, I believe it would be much less. One should bear in mind that the principal cost of maintaining a steam shovel plant is the cost of track and car repairs. I believe that an allowance of $1,000 a year of 150 working days for interest and depreciation on a $4,600 traction ditcher would be a liberal allowance. This would be equivalent to about $7 per working day, or less than 1½ ct. per cubic yard. Adding this 1½ ct. to the 3½ ct. gives us a total of 5 ct. per cubic yard for excavating clay of a kind that would cost 25 ct. per cubic yard by hand.

In discussing the probable cost of maintaining a traction ditcher, I have neglected to mention one point that seems to me very important. The digging buckets are fastened rigidly to the rim of the revolving wheel. There are no moving joints in the digging apparatus in which grit can lodge, so as to cause rapid wear and breakdowns. Of course the wheel type of trench excavator is limited in the depth to which it can dig. The largest machine thus far made digs a trench 4½ ft. wide by 12 ft. deep. For trenches of greater depth it will be necessary, therefore, to use some other type of trench excavator. But within these limits the wheel type of machine leaves little to be desired, being rapid, clean cutting and free from wabbling in its cutting, economic of operation and steady in its output under ordinary conditions.

On the Safeguarding of Lives in Theaters.--III.

Abridged from the Presidential Address before the American Society of Mechanical Engineers, by Mr. John R. Freeman.

Fire Curtain.—The third of the safeguards demanding investigation is the curtain for closing the proscenium arch. With good smoke vents and thorough automatic sprinkler protection over the stage and with ample stairways from galleries, it is probable that the audience could escape from a situation as bad as that in the Iroquois, although there was a very poor fire curtain, or perhaps no curtain at all; but in theaters, as in factories, it is wise to have a second and even a third line of defence, lest the first happen to be inoperative in the moment of need.

The fire curtain for covering the opening under the proscenium arch in nearly all American theaters outside Chicago, at the present time, is made from a heavy canvas woven from asbestos fiber; and in English theaters, the asbestos curtain appears to have been steadily gaining in favor because of its smaller weight and cost in comparison with a curtain of sheet iron, stiffened by ribs. In Chicago with the failure of the Iroquois asbestos curtain and with the excellent corrugated iron curtain of the Auditorium both before them, the Aldermanic Committee has made the steel curtain the rule.

Special attention was directed to the asbestos curtain in the Iroquois fire, from the fact that the curtain, although promptly let loose, failed to fall; because, as some say, it was blown outward from the stage by the strong current of air; or because, as others say, it caught on certain of the electric light shields. The asbestos canvas soon fell as mere rubbish to the stage, but so little that resembled a piece of asbestos canvas could be found on the stage that it was for some time believed that the curtain had not been made of asbestos.

Any asbestos curtain may be expected to resist the ridiculously inadequate test of the flame of a gasoline torch, and any well hung asbestos curtain, if it can be pulled down, will probably endure longer than the brief period of 2 or 3 minutes, within which it should be possible to empty any theater, and meanwhile it might serve a most useful purpose in screening the flames from direct view.

In opposition to the failure of the Iroquois curtain, we have a test of action of asbestos curtain and smoke vents combined, in the fire that destroyed the Girard Avenue Theater in Philadelphia on Oct. 28, 1904. On the arrival of the firemen 3 minutes after the first alarm, the flames were coming out of the skylight ventilators over the stage, of one-eighth its area, which it is stated had opened automatically. The firemen at first found no fire or smoke in the auditorium, and the curtain hung there, and probably with the aid of the cool in-draft toward the stage, kept flames out of the auditorium for a period said to be 15 minutes. Shortly after this, the fire somehow passed into the auditorium; doubtless around the edge of the curtain or by the curtain becoming ruptured by falling material.

In order to learn what difference there might be between different makes and grades of asbestos canvas, I obtained samples from 3 to 6 ft. square, from all of the prominent American manufacturers of theater curtains and each of the American manufacturers of asbestos cloth. I also had an architect familiar with theatrical work, collect samples of asbestos curtain cloth from the leading English manufacturers and dealers, under instructions to use every effort to procure some canvas that was woven from French or Italian or other than Canadian fiber. When pressed hard for the pedigree of their samples, no one of those makers would furnish asbestos canvas under a guarantee that it was made from anything other than the Canadian fiber.

Several kinds of asbestos canvas can be procured in the market. There is a distinction sometimes made in the trade between "absolutely pure" asbestos canvas, which contains no cotton, and "commercially pure" asbestos canvas, which may contain from 5 to 15 per cent. of cotton carded in with the asbestos fiber. These can be distinguished by picking a piece of the yarn into fine feathery condition and touching a match to the ends of the fiber and noting the flash and smell of burned cotton. Certain manufacturers claim that a small percentage of cotton, besides facilitating the spinning and weaving into a strong, pliable canvas, improves the cloth for the purpose of painting a picture upon it, as for a drop curtain, and this small amount of cotton does not impair its fire resistance. Asbestos fibers are very slippery and difficult to card and spin, and by taking advantage of the spiral structure of the relatively few cotton fibers to bind the asbestos fibers together, the process of manufacturing a smooth canvas is greatly facilitated. A third variety of cloth which has been highly recommended by fire chiefs and architects for a theater curtain, contains very fine brass wires, 33 and 34 standard gauge, woven in with the asbestos yarn. Our tests proved these fine wires to add nothing to its strength when hot.

Test of Asbestos Canvas.—Since our experiments on the effect of heat upon tensile strength of asbestos cloth and asbestos fiber soon disclosed that the ordinary commercial asbestos lost its strength at a heat just below redness, sufficient to drive off the combined water, in order to be sure of our ground I had three independent series of tests on asbestos made by three different experts. The results of all three tests proved independently that the character of asbestos cloth as to resisting a high degree of heat is utterly different from what is popularly supposed.

The first series of tests were made by Prof. Chas. E. Fuller, in the Mechanical Engineering Laboratory of the Massachusetts Institute of Technology, on a special testing machine designed for measuring the strength of sail cloth.

A specimen could be tested for strength either cold or while heated in either an ordinary gas flame or in the flame of the blast lamps. In brief, we found that every one of these speciments of asbestos canvas, when heated for 2 to 5 minutes to a little below redness in a common gas flame or barely to redness in the Bunsen flame, lost from 60 to 90 per cent. of its strength, and the fiber became very brittle.

A second series of tests were made at the Underwriters' Laboratory in Chicago by constructing curtains about 6 ft. square and testing them with the same furnace and apparatus provided for testing fire shutters and fire doors. This was in poor working condition because of a temporary defect in the gas supply, and after testing several curtains, we suspended these tests. These Chicago tests fully confirm the conclusion derived from our Boston tests, that asbestos cloth is rapidly weakened by the heat of an ordinary fire to an extent that makes a curtain composed wholly of asbestos cloth an unreliable fire screen for the proscenium arch of a theater, if expected to endure more than a few minutes, and it was proved that the asbestos canvas was so weakened that it would be ruptured easily by a blow from any falling material or by a strong current of air.

For the third series of tests, the friendly services of Prof. W. Otis Crosby of the Massachusetts Institute of Technology in charge of the department of economic geology, and Dr. C. M. Warren, professor of mineralogy in the same institution, were enlisted to examine all of the varieties of asbestiform minerals found in the extensive cabinets of the Institute of Technology and the Boston Society of Natural History, in the hope of finding specimens from some locality that possessed all the qualities properly attributed to asbestos. The result of this, in brief, was that nothing was found possessing characteristics materially different from the hydrous Canadian fiber on the one hand, and the anhydrous fiber from Georgia on the other. The first class lost their strength at a heat which drove the water off; the second class were too stiff or brittle for spinning and weaving or occurred in quantity too small for commercial purposes.

Upon testing specimens of the Canadian fiber by heating in a platinum coil heated electrically, raising the temperature slowly, weighing the specimens repeatedly and all the time measuring the temperature in the crucible by electrical methods, it was found that a temperature up to 250° C. caused no driving off of the water chemically combined, and no apparent change in the pliability or strength of the fiber. A heat just below dull redness proved to be the critical point. One half hour at from 440° to 480° Centigrade, equivalent to 850° Fahr., drove off about 3 per cent. of the combined water and made the fiber slightly more brittle than at first, with some loss of natural luster. Heated to from 630° to 650° C. for 3 minutes, 11 per cent. of the water is driven off, and the fiber becomes slightly brown and very brittle and crumbly.

Steel Plate Protected by Asbestos Material.—In our Chicago furnace tests, we also experimented on combinations of asbestos, asbestos felt and asbestos cement with thin steel plate and combined with wire netting, the asbestos being placed on the stage side in the hope that it might shield the steel from the full heat and thus prevent it showing red hot on the auditorium side, while the steel would give strength. These tests were carried far enough to prove an endurance more than ample for their purpose as a shield while audience is escaping, and it was plain that the steel curtain protected with some asbestic material on the fire side possessed far greater strength and endurance against fire than simple asbestos.

The general type of steel proscenium curtain finally adopted in Chicago and required at all theaters, was worked out somewhat hurriedly according to the average judgment of the Aldermanic committee in advance of any other tests than the failure of the Iroquois curtain.

It consists of a light frame work of steel angle irons with corrugated plate about 1/16 in. thick on the auditorium side, and some asbestos nonconducting material on the stage side, with an air space of 1, 2 or 3 in. between. Where guided only by loops on vertical cables, it is required to lap over the edge of the arch about 8 in. A structure of this kind of the ordinary size weighs from 2 to 6 tons.

The hanging would be improved by more substantial iron channels to hold the edge, and by the addition of positive down-haul tackle or some arrangement by which the counterweight could be thrown off, for now the great weight of these curtains is so nearly counterpoised that conceivably the air pressure against its surface may prevent the slight excess of gravity from lowering it.

Fire-Proofing of Scenery.—Scenes are ordinarily painted on strong linen canvas weighing about 6.6 oz. per square yard. Heavy cotton sheeting is sometimes used for the cheaper temporary productions. The gauze used for skies and transformation scenes is of cotton, of texture like mosquito netting. Frames and battens and profile backings are of white pine. The canvas is first stretched on a frame and stiffened by a coat of glue size applied warm with a broad brush. Next,

it receives a priming coat of whiting and glue size and is then ready for the scene painter. The mineral colors used are mixed with water and glue, and many tests prove that the painted canvas is somewhat less readily combustible than the unpainted, and the heavier the coat of pigment, the more the flame is retarded.

The best we can hope to accomplish in improving this scenery is to "flame-proof" the fabric so that it will not ignite from a match, an electric spark or a gas jet, or so that if ignited it will not burst into flame. This much of protection is of great value and worth all that a good process costs, if it can be accomplished in practice without injury to fabric or colors, for if we can thus prevent the little flame from quickly spreading, we have removed perhaps nine-tenths of the danger of a fire starting on the stage. Once get the gauze and canvas and pine on the stage enveloped in flame, nearly everything "fire-proofed" would burn to total destruction with substantially as great a rush of flame and suffocating smoke as with the untreated material. Indeed, the chemicals may make the fumes worse.

The efficient fire-proofing of the great quantity of white pine used in frames, battens and profiles, 8,000 sq. ft. in the case of the Iroquois, appears to be a practical impossibility. The 11 miles of manila ropes cannot be "flame-proofed" without too great sacrifice of the strength.

Our various tests interpreted from the scientific point of view indicate that about all that we can hope for from the application of "fire-proofing" chemicals is as follows:

First, it may keep the surface near the applied flame bathed for a few seconds in a thin film of steam or inert gas, arising from the distillation of the microscopic quantity of the chemical lodged in the fabric, thus keeping the oxygen of the air away from the carbon for a moment.

Second, the dissociation or distillation of this little quantity of the chemical absorbs a little of the heat applied or revolved.

Third, the chemical used may have a non-volatile base which will fuse and cover the surface of the combustible carbon with a glassy film that although exceedingly thin, will keep this carbon beyond reach of the oxygen of the air. This may perhaps lock up from 25 to 50 per cent. of the heat giving content of the fiber.

After each of the great historical theater fires, this subject of fire-proofing cloth has been studied by chemists of eminence, and nearly all of the chemicals and compounds recently brought forward by scenic artists and dealers in painters' supplies are the same that have been recommended over and over again for the past 50 years.

After some preliminary trials with the assistance of the chemical engineer of the inspection department of the Factory Mutuals and conferences with the experienced scenic artists, Burrage of Chicago and Story of Boston, and after reviewing the probable effect of various solutions upon the fabrics and upon the ordinary colors used by the scenic artist with some of my personal friends who were of wide experience as chemists of textile factories and chemical works, I enlisted the constructive genius of my friend, Mr. Geo. C. Whipple, consulting engineer, director of the Mt. Prospect Laboratory in Brooklyn, and of Mr. Irving W. Fay, professor of chemistry in the Brooklyn Polytechnic Institute, in the hope that starting with the theory of the successful action of ammonium phosphate as stated above, we could find some substance of equal value as an antipyrine that would be less likely to injure fabric or colors.

The results may be summed up as follows:

1. Phosphate of ammonia was found the most efficient antipyrine.

2. Tungstate of soda, so often found recommended in the text-books, was found to possess very small value.

3. The various proprietary solutions when analyzed were found to be all based on one or another of the ammonium salts, commonly the phosphate but frequently the cheaper sulphate substituted in whole or in part.

4. Linen canvas or cotton cloth, fire-proofed in the best manner possible by any of these solutions, could be quickly burned to total destruction if a sheet were rolled in a loose coil with the axis vertical and a space of perhaps ½ in. between the folds, and a fire then lighted with a small wad of excelsior at the bottom of the roll; this method of test serving to confine the radiant heat and the gases distilled from the fiber. This was of special interest since strips of the same cloth tested in the manner that has satisfied previous experimenters, by holding the strips of treated cloth vertically over an ordinary Bunsen flame, could not be ignited and appeared almost perfectly flame-proof.

5. The most efficient part in the fire-proofing of fibers was found performed by the covering of the fiber with a non-volatile liquid that excluded the oxygen. Phosphoric acid proved better for this purpose than any other substance tested, but obviously could not be applied alone because of its corrosive action on fibers and colors.

6. The ammonium in combination with it in phosphate of ammonia was found of value chiefly in locking up the corrosive quality of the phosphoric acid until released by the heat of the fire and thus giving a comparatively harmless compound for application to color and fabric.

7. The method of application of the fire-proofing solution to the canvas was found to have great influence on the degree of fire protection secured. One of the best solutions, when brushed cold over the back of old scenery, penetrated the fiber so little as to be of no value, but when applied hot was efficient. Under some conditions, the linen canvas is repellant of water, as one finds on trying to dry the hands on a new crash towel. When the liquid is applied rapidly to a vertical surface, with a brush, linen cloth does not absorb it readily. Hot application of the solution adds much to its efficient penetration of the fiber. For new scenery, probably the best method is to saturate the canvas between rollers in a bath. The next best method is to mix the chemicals with the water of the glue size.

8. Tests of the tendency of the various chemicals to induce decay were made by sowing some of the treated samples with mould spores. Other tests were made by adding various percents of phosphate of ammonia to nutrient gelatine and to mixtures of the glue size and incubating these for tests of bacterial growth.

9. The effect of the solutions on the colors ordinarily used by the scenic artist was not found bad, except in case of some of the more delicate blues and greens, but a greater length of time would be necessary before positive statements about this can be made.

10. When canvas that has been flame-proofed is actually burned, as it may be under practical conditions, it gives off fumes that may be even more dense and suffocating than those from the untreated canvas.

Fire-Proofing Wood and Fire-Proof Paints.—Since the pine frame work of the set pieces and wings presents a greater quantity of fuel than the canvas itself, it would be desirable to flame-proof this wood. A simple brushing over with phosphate of ammonia or other chemical solutions is found inefficient. Various processes for making wood fire-proof have long been known and have been used on wood for interior finish and trim of fire-proof buildings, more in New York City than almost anywhere else because of certain favoring clauses in the building laws. The various tests made by Prof. Norton of the Massachusetts Institute of Technology and others have shown that although the wood is much less readily ignited after treatment, no real fire-proofing results.

Fire-proof paints are sometimes required by law to be applied to wood-work about the stage. The Underwriters' Laboratory at Chicago has made an extensive series of tests of all of the prominent ones in the market, which show that none has any noteworthy value in flame-proofing wood. For confirmation, I requested Messrs. Fay and Norton to make tests of a few of those most prominent in the market. They purchased commercial samples and made chemical analyses of several; each was found to be mainly a sort of white-wash consisting of slaked lime, finely pulverized asbestos, with also a little alum, gypsum and glue. The paint adhered well when applied to canvas, but was quickly proved by test to have almost no flame-proofing quality whatever.

Dry Powder Fire Extinguishers.—On and about the stage of the Iroquois Theater were several tubes of one of the numerous dry powder fire extinguishers in a long red tube that have been so vigorously pushed into notice by enterprising salesmen during the last few years. One of the men on the stage promptly and courageously tried to extinguish the fire with this powder, and, of course, he accomplished nothing whatever. The chief reason why these long tin tubes of dry powder have become popular is that they can be manufactured for about 10 cents each, and that they retail as high as $3.00 each. They are nearly all composed of common bicarbonate of soda, frequently disguised by the admixture of a little cheap coloring matter like Venetian red and prevented from caking by the addition of starch. The bicarbonate of soda can be purchased in quantity for about 1¾ cents per pound. Each tube commonly contains 2½ to 3 lb. The cost of the tin box and its gorgeous label may be enough to bring the whole up to 10 or 15 cents.

I have heard remarkable stories of what they will do. Remarkable exhibitions are sometimes given under circumstances specially devised. A New York friend, a chemist, was given an exhibition by a man who poured a thin stream of benzine on the floor, lighted it and extinguished it by the use of some of the powder. My friend was impressed, but did some experimenting at home and found that after a little practice, he could do the same with either sand or salt. We had tests made of two of them by our inspectors a few years ago and found them of doubtful value on the smallest fires and worthless for a fire in free ventilation.

On the other hand, the "soda water fire extinguishers," consisting of a copper cylinder containing 2, 3 or 4 gal. of a strong solution of bicarbonate of soda, with a bottle of acid at the top so arranged that it can be upset into the soda and water, thereupon generating a strong pressure by the evolution of carbonic acid gas, are excellent for many situations where pails would be unsightly.

As showing what people will pay good money for in the effort to get fire protection, I was interested in the story that one of my agents, a chemist, brought in about hand grenades. We had purchased examples of some of the different kinds of hand grenade and had their contents analyzed. In the case of particular interest, the salesman offered as proof of the superior merits of his compound, the statement that a quantity had just been purchased by the United States Government for the protection of one of the battleships. Our analysis shows the contents to be simply water and common salt. I myself saw a hand grenade of the same appearance bearing the same label in the model of the battleship at the St. Louis exposition, so perhaps it is true that the United States Government purchased salt water at 50

cents per quart bottle for the fire protection of battleships.

Philadelphia Fire Escape.—A type of fire escape has been developed under the building laws of Philadelphia primarily for use in factories, which is so remarkably efficient and so far ahead in safety of anything else that exists that we may wonder why it has not been copied in other cities. It is somewhat expensive, but the safety it gives is well worth the extra cost. The fundamental idea is that the stairway tower is absolutely cut off from the various rooms and floors which it serves. One must go out from the room into the open air and then enter the stairway. Once within this, he can proceed without danger to the bottom. The same idea can be applied to the fire escapes from a theater.

The great lesson out of all the theater fires as to the danger to those in the gallery should not be forgotten in designing the stairways and fire escapes. The area, the total number of stairway exits, and the total width of stairway per hundred persons, should be two or three times as great for the gallery as for the other parts of the house, and all exits should run in such a direct and obvious course that with a person once in them, he could not fail to find his way to the bottom, although in total darkness. The flights of stairs should be each of the fewest steps practicable, with frequent landings on which one can steady himself and with good, simple, continuous handrails that can be followed down each side and a strong center rail, continuous all the way, where wide stairs are necessary.

Weekly Inspections.—In safeguarding our factories against fire, we find systematic inspections and the filing of a weekly report one of the very best means toward safety. They would be of equal value for the theater. A printed blank can readily be devised for each case. This should cover the completeness and operative condition of all valves, fire hose, sprinklers, fire pails, soda water extinguishers, hooks, fire doors, exit locks and latches, smoke vents, fire curtain mechanism, and particularly of the neatness, cleanliness and order of every room, passageway, closet, air chamber, loft, basement and fly gallery, used as a part of the theater building. This inspection should be made on each Monday afternoon, since the week end is the time when attractions are commonly changed and the confusion of new seats is most apparent.

A private fire brigade from the regular stage hands and ushers should be drilled regularly, the Monday drill to be a "wet drill," testing the stage hose and a few of the soda water extinguishers, which may be turned out of the window to the area way, or into some convenient drain provided for the purpose, at the rear of the stage.

If the municipal ordinance required such reports and drills as just described, and that a duplicate of the report be filed each Monday afternoon with the public fire chief of the district, a single fireman or inspector detailed as instructor to cover all the theaters of a large city, would, in my judgment, accomplish much real good than the two stage firemen required by law to be present from the public force, doing nothing in particular, at the expense of the theater, and who from my factory experience would be less efficient than the trained and responsible stage carpenter.

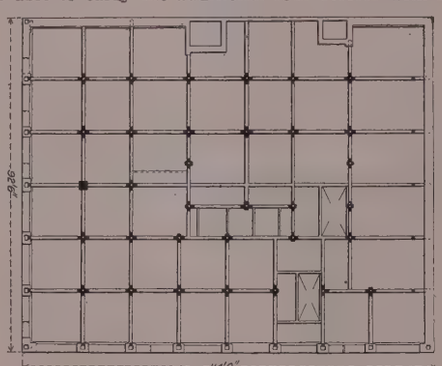
Remodeling the St. Nicholas Hotel, St. Louis.

By Lionel R. Viterbo, C. E.

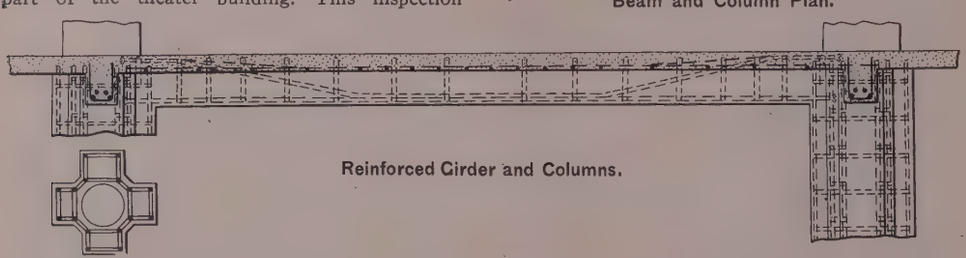
The St. Nicholas Hotel on the northwest corner of Locust and Eighth Sts., St. Louis, has recently been purchased by the Marlborough Realty Co., which is remodeling and transforming it into a modern office building. The hotel is a six-story and basement building, and in order to transform it into a suitable office structure four additional stories have been deemed necessary. The plans for the new building have been drawn by Messrs. Eames & Young, of St. Louis, and the general contract for the remodeling has been let to the Southern Illinois Construction Co., of East St. Louis, Ill.

It is easy to see at a glance that such remodeling involves some rather difficult and very interesting problems, among which the most important are the reinforcing of the members submitted to direct compression, and the widening of the foundations under them. The columns of the hotel, which are of cast iron, were designed to support the six stories of the building with a factor of safety of six. The area of the foundations under them was determined so that the pressure on the ground under the full dead loads and a certain percentage of the live loads would not exceed its safe carrying capacity.

It was found that the cast-iron columns would be able to carry the additional four stories with a factor of safety of four, but would not be sufficiently strong to resist the buckling strains resulting from the combined dead and live loads. It was also found that if the foundations under the columns were not widened, the pressure on the ground per unit area would become dangerous. In order to overcome these two dangerous conditions, it was absolutely necessary to reinforce the cast iron columns and to increase the area of foundations. The solution adopted, probably the only suitable one in the present case, was to use reinforced concrete.



Beam and Column Plan.

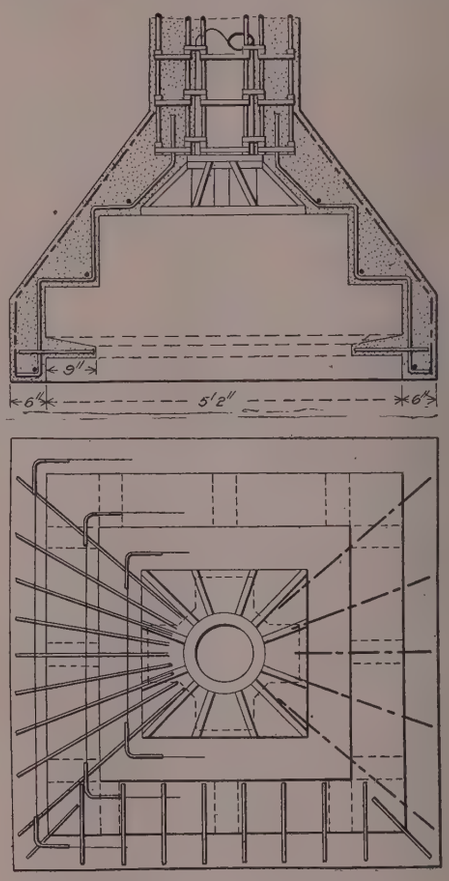

Reinforced Girder and Columns.

The first floor of the old building has been torn down and will be replaced by a floor entirely of reinforced concrete. The columns in the basement are reinforced as a rule with sixteen round bars ½ in. in diameter, tied together every 8 in. by means of collars made of No. 19 hoop steel gauge ¾ in. wide.

It is to be noticed that not only are the cast iron columns properly reinforced against buckling, according to Gordon's formula, but that around each cast iron column are formed four reinforced concrete columns solidly binded together, each of which will support a reinforced concrete beam as shown in the floor plan.

The panels in the first floor are 4 in. thick and reinforced crosswise by means of ½-in. round bars running in both directions. The columns above the basement are reinforced with four round bars tied every 12 in. by means of collars made of hoop steel; the dimensions of the concrete around the columns and also those of the steel reinforcement were determined in each story by means of Gordon's formula.

Details of one of the footings are shown in the illustrations. This is at present 5 ft. 2 in. square and is to be increased to 6 ft. 2 in. square. In order to do so a slot 9 in. deep will be cut near the bottom of the old concrete; this slot will not be continuous but interrupted on each side by three buttresses left for the purpose of not weakening the footing beyond safety. Then the mould, the interior dimensions of which are to be 6 ft. 2 in. square, will be placed in position and 36 rods ½ in. in diameter will be equally spaced in the slot and 36 other rods ½ in. in diameter and step-shaped will be placed in as many vertical planes, radiating from the axis of the column.



Reinforcement of Column Footings.

The concrete will then be poured and extra care will be taken to thoroughly tamp it in the slot. A perfect bond will thus be formed between the new concrete and the old one, by means of the horizontal rods, which will furthermore take up the vertical shear resulting from the upward pressure.

On one side of the building a row of columns will be built 3 ft. from the wall and resting on them will be concrete girders forming cantilevers, which will carry the walls above.

The details of the reinforced concrete construction have been drawn by The Reinforced Concrete Construction Co. of St. Louis, and that part of the work will be carried out by the Columbian Fire Proofing Co. of Chicago under the full supervision of the Reinforced Concrete Construction Co.

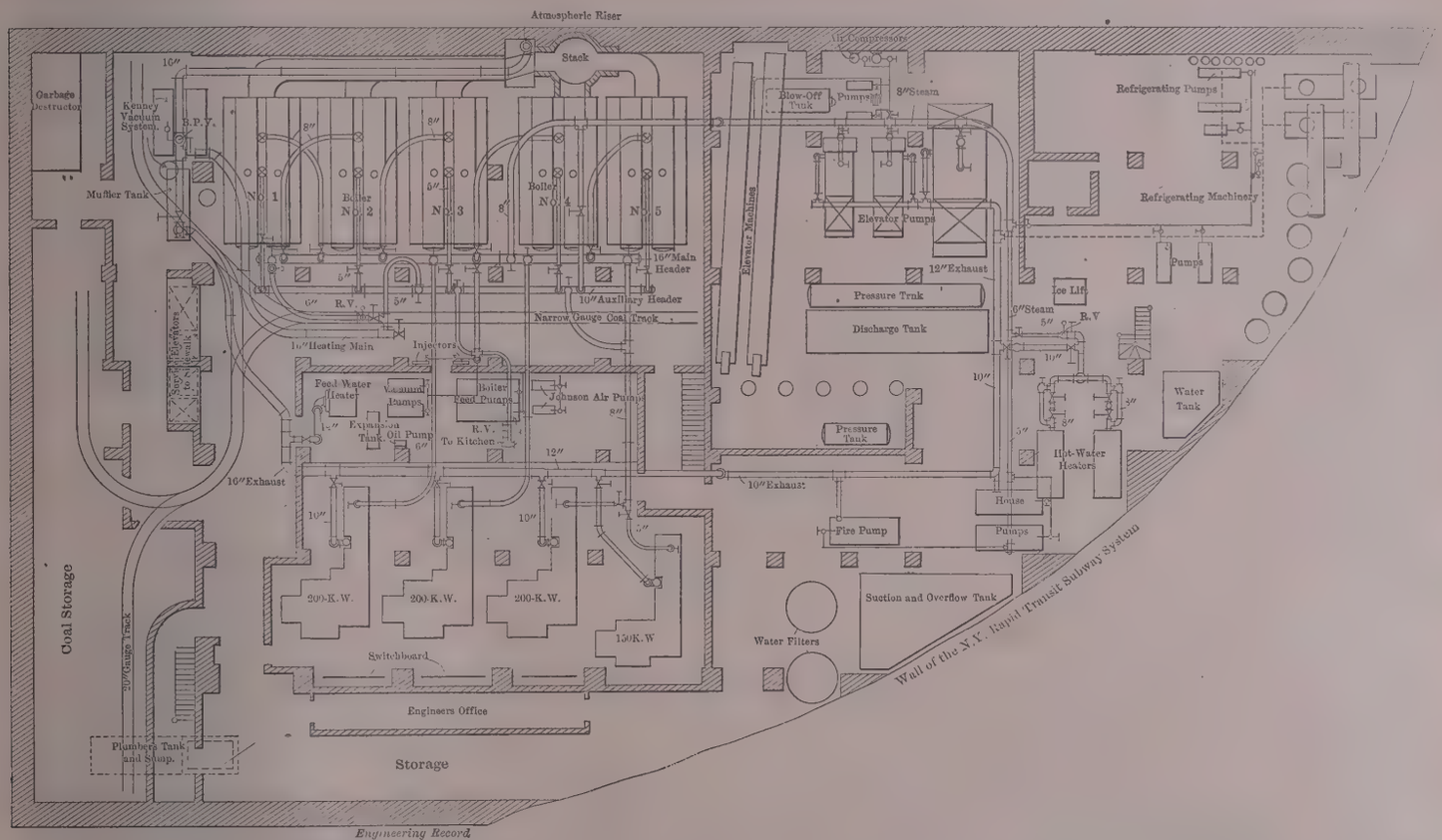
The Mechanical Plant of the Hotel Belmont, New York City.—I.

The Hotel Belmont, at 42d St. and Park Ave., New York, is one of the largest and most elaborate structures of the kind in the city, having accommodations for nearly a thousand guests. It covers a large plot which had been secured by the Interborough Rapid Transit Co. to permit a long-radius curve in its subway from Park Ave. into 42d St., the tracks passing between the columns of the building and occupying the entire northeast corner of the site below the basement level. It is a steel-cage structure, 23 stories high above the street level, and has five stories beneath the surface, to accommodate the extensive machinery equipment, storage and service facilities. The interesting features of the construction, as well as the difficulties encountered in excavating the basement to a depth of 60 ft. without danger to adjoining tall buildings, were described in detail in this journal on Feb. 7, 1903.

The structure occupies the entire block upon the west side of Park Ave. between 41st and 42d Sts. with frontages of 106 ft. on the latter. It has a main entrance on 42d St. opposite Grand Central Station, with side entrance on Park Ave., while in the basement there is a passage leading directly to the adjacent express station of the subway system; the latter passage also leads across to Grand Central Station. The service entrances to the building are on the 41st St. side and inasmuch as the subway encroaches so closely on the 42d St. and Park Ave. sides, a right was purchased from the city to extend the five underground stories 30 ft. beyond the curb line to the center of 41st St., by which a large amount of additional space was secured for the service departments. Thus, below the street level the building has a total floor space of 120x220 ft. while at the first floor level it has exterior dimensions of 106x198 ft. Above the parlor floor the building divides into three wings at the rear side, with 14-ft. court spaces for lighting and ventilation, skylights at the base of which afford ample lighting for the palm room and corridors upon the mezzanine floors.

The interior arrangement of the hotel has been laid out with special reference to the best elevator service, the main group of five passenger, four freight and service elevators and the dumb-waiters having been located practically in the center of the floor plan, with stairways at either side opening off the main corridor. Each of the eighteen guest room floors has 36 bedrooms, or 648 rooms in all, of which one half on each floor have bath rooms. On the parlor floor there are two groups of state apartments, each having two bedrooms with bath, and there are also a large banquet room and four large suites each with bedroom and bath. This brings the total number of bedrooms available for guests up to 656. The help are provided for in a dormitory on the 21st floor containing 53 bedrooms, with separate bath and toilet facilities. The main floor and its mezzanine gallery is devoted to the hotel offices, a palm room and the main dining room, while in the basement there is a large restaurant and grill room. The south half of this first basement contains the kitchen and bakery, on the 41st St. side, below which, in the second basement, are the stores for the kitchen supply, servants' dining room, toilets, etc., while at the 42d St. end are the barber shop, manicure and hairdressing rooms, and the corridor leading to the subway station. The third basement contains the main laundry, extensive storage facilities for both guests' baggage and hotel supplies, a printing office, a surgeon's office, locker rooms, etc. The construction of the building is fireproof throughout, the Roebling system of floor construction and partitions being used.

Mechanical Apparatus.—The mechanical equipment of the hotel includes much that is novel and interesting in operative methods. It embraces a 1,700-h.-p. boiler plant, 1,200 h.-p. of electrical generating apparatus, an exhaust steam-heating equipment, extensive ventilating systems, 16 elevators, 10 electric dumb-waiters, a 75-ton refrigerating plant, a pneumatic tube system, vacuum cleaner system, garbage destructor, etc., all of the apparatus for which is installed within the narrow confines of the lowest two stories of the sub-surface section of the building, the three basement floors above being left entirely free for the hotel service. The resulting arrangement has, however, proved convenient and all machinery is accessible. By means of ample fresh air supply and ventilation facilities these lower basement floors have been rendered fully as comfortable to work in as if on ground level. By means of a deep areaway between the building walls and the sidewalk on the Park Ave. and 41st St. sides, daylight is secured in a large portion of the three upper basement stories.



Plans of Fifth Basement, Hotel Belmont, Containing Power Plant, Refrigerating Machinery and Elevator Equipment.

The power plant proper occupies a two-story space at the 41st St. end of the two lowest basement stories, which embraces an area of 100x108 ft., with 20 ft. clear headroom beneath floor beams of the third sub-basement, resulting in a large boiler and engine room, with ample space for the piping and ventilation ducts overhead. This area includes an extension of 30 ft. beyond the curb line to the center of the street, the right to which was purchased from the city, which affords ample space for a service entry to the building and the extensive coal storage. The coal storage occupies a space 80 ft. long with an average width of 16 ft. and has a total capacity of 800 tons. The boiler room is at the rear of the building and occupies a floor space of 50x94 ft., or 2.75 sq. ft. per rated boiler horse-power. The 50x70-ft. engine room, which contains also a number of auxiliaries, is at the front of the building. Storage and repair shop facilities for the mechanical plant are provided in an 18x90 ft. space at the rear of the switchboard, under the Park Ave. sidewalk.

The balance of the fourth and fifth basement

stories, which have triangular floor plans owing to the subway structure cutting off a large portion of the northeast corner, is devoted to the extensive auxiliary mechanical apparatus required for the hotel service. There is in the fifth story the hydraulic elevator apparatus, including pumps and tanks, the fire and service pumps, water filters, hot-water heaters, tanks, and the refrigeration system. The equivalent space on the floor above, the fourth basement, is devoted mainly to ventilating apparatus, storage facilities and the like. A gallery is carried on this level across the engine room to afford communication from the lowest elevator levels and the rubbish chute to the destructor at the rear of the boilers. Communication with the upper floors is afforded by two stairways. The handling of heavy pieces of machinery is facilitated by four service elevators of the plunger type, which operate from the boiler room to the 41st St. sidewalks. The entire arrangement is interesting on account of its comparative simplicity for an installation of this size, and the accessibility to all apparatus.

Boilers and Auxiliaries.—There are five Babcock & Wilcox water-tube boilers, located in five independent settings at the rear side of the boiler room. Spaces of 2 to 5 ft. are left between the settings and at the ends to permit access for cleaning, and there is a 7-ft. space at the rear, where the blow-off piping and drip lines are placed. The firing floor in front of the boilers is 20 ft. wide, and contains a Hoshor-Platt narrow gauge industrial track for the delivery of coal in hopper cars. Between this track and the boiler fronts the floor is paved with heavy cast-iron tile, with corrugated wearing surfaces. The service elevators from the sidewalk on the 41st St. side open into the boiler room so that machinery and supplies are received at this point in the basement.

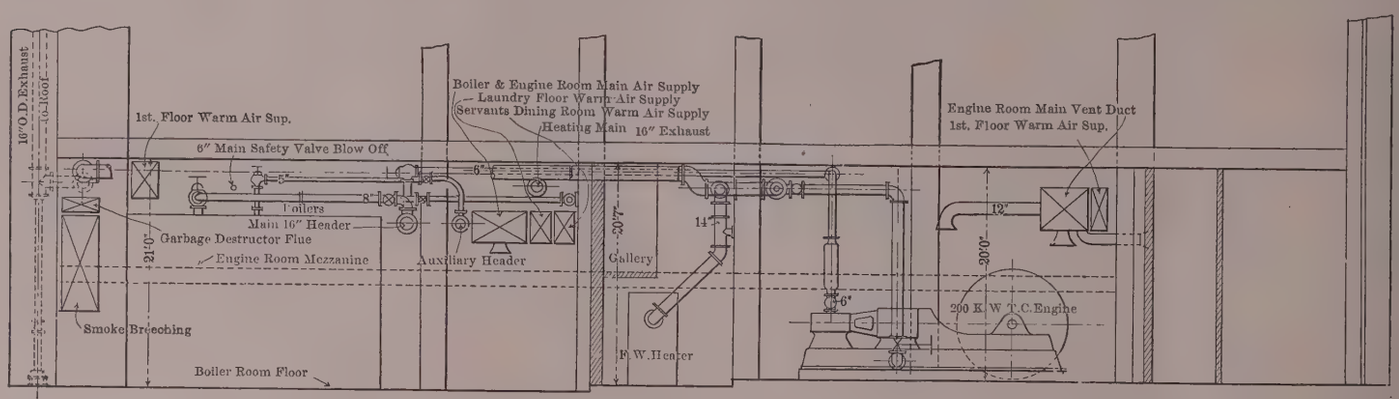
The boilers are of 335-h.-p. rated capacity, each having 3,355 sq. ft. of heating surface. The construction is of the wrought-steel heavy-pressure type of the Babcock & Wilcox Co., designed for a working pressure of 150 lb. if desired, although the pressure normally carried is 125 lb. There are two steam drums, 42 in. in diameter and 23 ft. long, with ½-in. shells, and a 12-in. mud drum of cast-iron, tested to 400 lb., to which are connected the lower ends of the tube sections. Of the latter there are sixteen, each section consisting of ten 4-in. tubes, 18 ft. long, making 160 tubes per boiler. The steam drums are connected by a cross balance pipe to which the 8-in. outlet nozzle is connected. Each boiler has two 4-in. Consolidated nickel-seat safety valves set for 150 lb.; the outlets of these valves are connected to a 6-in. pipe header which discharges the waste vapor into the stack flue.

The boilers are hand fired, the furnaces being equipped with the improved McClave grate bars having double cut-off movement for ease of removal of fine ashes or dumping the entire fire. The grates are of fine mesh to provide for the burning of anthracite pea coal, and a special feature of this grate is that it permits a thorough shaking movement without increase in the size of the openings and consequent loss of fuel. The dead plates and the flame bridge plates are fire-brick lined, and all interior wall surfaces of the settings are faced with fire-brick laid in kaolin. The products of combustion are led to the base of the vertical stack through rectangular sheet metal breechings located at the rear of the boilers. They are built of No. 8 gauge wrought iron, with heavy angle iron corners, and have cross-sectional areas equivalent to the combined areas of the dampers in their connections to the boilers. The latter dampers are all controlled through a system of shafting from a Kieley automatic damper regulator, which is set to operate on a variation of ½ lb. in the main header. The stack is of steel plate 7 ft. 2 in. in diameter and rises at the rear of the boilers, passing into the air-shaft areaway at the rear of the building at the second floor level, whence it continues to a hooded outlet at the top of the building.

Coal storage for 800 tons is, above stated, provided in the vault under 41st St., into which the coal is chuted directly from sidewalk coal holes above. An industrial railway of 20-in. gauge leads to the vault through two doorways, so that the coal may easily be delivered to the firing floor, side-opening steel cars being used from which the coal is handled directly in firing. A simple floor arrangement was secured by forming the rail grooves for the wheel flanges in the cast-iron floor tile so as to present an unobstructed floor surface. The cars are of steel frame construction with automatic-swing trucks, designed to operate around 12 ft. radius curves easily. There are three coal cars, all of 1-ton capacity, one of similar size for ashes and one for garbage, which will be burned partially in the boiler furnaces and partially in the destructor in the room at the rear of the boilers. Ashes are removed to the street level, by means of the service elevators, in the usual ash cans for delivery to the city wagons.

The boiler feeding consists of a duplicate equipment of injectors and duplex feed pumps, either of which may be relied upon to operate the plant. The injectors will, however, be normally held in reserve for emergency use, as the pumps are to be used for the return of condensation from the drip systems from the heating systems and steam mains to the boilers. There are two of these boiler feed pumps in duplicate, each a 7½x5x10 in. Worthington duplex pump with pump governor for automatic feeding. They are located in a section of the engine room which is devoted to pumps, the feed water heater, etc.; an interesting feature of the equipment is that these feed pumps are cross-connected with the five water pumps for the various classes of service so that they may be used interchangeably for almost any purpose. There are two Nathan Monitor injectors in the boiler room, with connections complete for use as an auxiliary to the feed pumps if necessary; their cold water suctions are taken from city water mains, while their delivery is made through the main used by the pumps.

The boiler feed line is of seamless-drawn brass piping and bronze fittings, and embraces a 4-in. connection from the pump delivery outlets to a longitudinal feed header of similar size extending over the tops of the boilers. The boiler branches are of 2-in. pipe, and are connected to each boiler through a check valve between two gate valves, to permit of quick access to the check. All the valves in the feed system are Walworth extra-heavy screwed-pattern bronze gate valves while the check valves are Pratt & Cady extra-heavy swing checks. The 6-in. feed pump suctions are taken from the Webster open feed-water heater and purifier, which is also located in the engine room near the pumps, with by-pass connections to water service lines for emergency use. The heater is the vertical rectangular class EC open type built by Warren Webster & Co., Camden, N. J., designed for operation under the back pressure of the exhaust in the heating system. It is rated at 2,000 h.-p., having a capacity for heating 90,000 lb. of water per hour from a temperature of 45° to 210° Fahr. For this approximately 14,000 lb. of steam is required per hour, which condenses and adds its bulk to the feed water in the heater. The Webster air line attachment prevents the heater from becoming air-bound and entrained oil from the engines is extracted from the exhaust steam by a separator which forms the exhaust inlet to the heater.

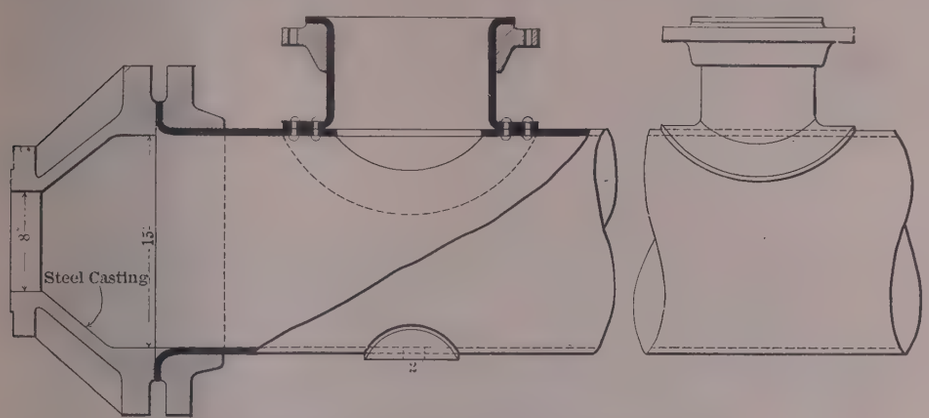


Cross Section of Fifth Basement Through Power Plant.

The boiler blow-off system has a 4-in. main of extra strength wrought-iron pipe extending behind the boiler settings with two 2½-in. connections to the mud drum of each boiler. The branch connections have a Babcock & Wilcox special angle blow-off valve and a Walworth extra-heavy bronze gate valve in each; where these branches pass within the setting they are protected from the heat by terra-cotta sleeves. The 4-in. blow-off main is extended through from the rear of the boilers into the elevator pump room, where, in the rear corner, is located a horizontal cylindrical blow-off tank with two duplex steam pumps for automatically removing the water as it accumulates. These are located in a pit, 7x20 ft. in size and 10 ft. deep, so as to permit the tank to receive the ground drainage from beneath the building and foundations and serve as a general sump. The lining of the pit is ½-in. steel plate with angle iron bracing, and is finished flush with the floor level with a 3x4-in. angle which serves as the base for a double pipe railing surrounding the pit.

An interesting feature of the blow-off tank is the use of large cooling coils for lowering the

temperature of the water discharged from it into the sewers, in accordance with local city ordinances, to prevent damage to sewers from excessively hot water and the annoyances of steam escaping through manholes. The tank is, in the first place, of adequate size to permit proper cooling, being 4 ft. in diameter and 10 ft. long, built of ½-in. steel plate, thus providing for a capacity, when filled half full, of 470 gal. The cooling coil consists of ten loops of 2-in. seamless hard-drawn brass pipe, built up on 5-in. pipe manifolds within the tank, as indicated in the accompanying drawing. Each loop contains about 22 ft. of pipe, so that there is in all 220 ft. of cooling surface. The construction of the coil is such that it may easily be removed from the tank for cleaning, if necessary. The waste heat which goes to the tank in the blow-off, the drip returns, etc., is by this means utilized, inasmuch as the water used for cooling is taken from the city mains and normally passed to the hot water heaters for the house service, although piping connections permit it to be passed to the feed-water heater if desired.



Details of Construction of High-Pressure Steam Header.

This blow-off tank, in addition to receiving the boiler blow-offs, has connections from the dirty low-pressure exhaust drip line, the relief line from engine snifting valves, and also from the clean high-pressure main drips for possible use if the feed water heater is out of commission, thus serving as a general sump, as before stated. It is automatically emptied by either one of two 6x4x6-in. Worthington duplex pumps which lift its contents to the level of the street sewers, the lowest of which is about 30 ft. higher than the bottom of the tank; a Utility pump governor in one end of the tank controls these pumps so that it is maintained approximately half full. There is a vent connection leading from the tank to the roof of the building for removal of vapors and air given off from the water discharged to it; the vapor line is 5-in. pipe and joining the 3-in. vapor line from the expansion tank for the feed water heater leads up as a 6-in. riser, through the pipe shaft adjacent to the smoke stack, to an outlet at the roof.

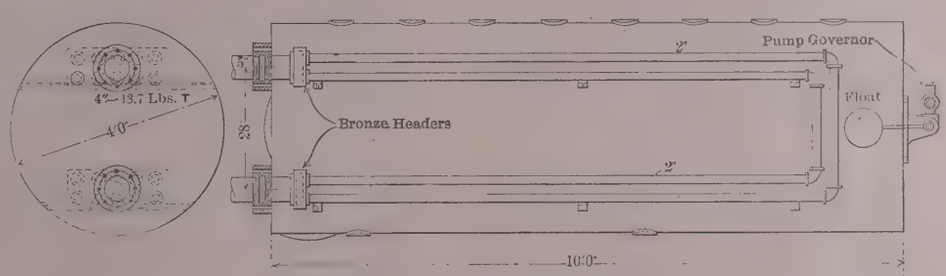
Piping.—The high-pressure piping is worthy of note for the simplicity of the arrangement, which embodies practically a duplicate system, with connections from either branch to nearly all of the more important steam machinery. The system originates in two steam headers in the boiler room, one of 16-in. pipe, which is known as the main header, and the other, an auxiliary header, of 10-in. pipe. The main header has 8-in. pipe branch connections to the main nozzle of each boiler, which is located on the balance connection between the two steam drums. Each branch connection has two valves, the one at the nozzle an automatic stop and check valve of extra-heavy pattern built by the New Bedford Boiler & Machine Co., which is guaranteed to close steam tight in case of sudden drop of pressure in the boiler, and the other next to the header, an extra heavy Walworth gate valve with by-pass. The auxiliary header is connected to each boiler by a 5-in. branch from a nozzle between the two safety valves on the forward balance pipe, which branches are valved similar to those from the main header.

From the main header connection is made to all of the engines, pumps, air compressors, and other apparatus, through long-radius bends of wrought-iron pipe, Austin separators, and Walworth gate valves, as indicated in the piping plan. For the engines branches are taken off directly from the boiler headers; two of these are individual, while for the other two engines a single branch is used to supply both, which branch has also a by-pass connection to the auxiliary header. The latter two engines have duplicate methods of supply which will thus provide for adequate capacity in electrical generation under emergency conditions; the first two engines have only a single source of supply. The elevator pumps, air compressors, refrigerating and house pumps, and hot water heaters, are supplied by a single 8-in. main which leads off from the main header with a 6-in. connection to the auxiliary header. Another duplicate connection is made from both headers to a 5-in. line which supplies the group of boiler-feed, vacuum and other pumps in the engine room. From the latter branch, connections are made through Kieley reducing valves to the low-pressure (30 lb.) systems for the laundry and kitchen services. A 6-in. connection from the main header through two Kieley reducing valves is also made to the heating main for make-up in case of deficiency of the exhaust, this being duplicated by a 5-in. connection to the auxiliary header.

The exhaust steam system consists of a single line carried around the entire fifth basement floor, so as to afford connection with all steam-driven machinery, ending finally in a 16-in. exhaust riser in the pipe shaft adjacent to the smoke stack, where it rises to an exhaust head at the roof level, some 320 ft. above. The system begins with 7-in. pipe at the elevator pumps, enlarging to 12-in. pipe where it passes the refrigerating machinery section, making connection with a number of pumps. At this point a branch is taken off to supply low-pressure steam to the hot-water heaters for the house service, for which a considerable amount of steam will be required, so that the main is reduced to 10-in. pipe beyond that point. The line is then continued in the reduced size in the circuit around the building, receiving the exhaust of the house pumps, the fire pump and then of the engines in the engine room. Here the line increases in steps to 12-in. and finally to 16-in. pipe, and leads on, with a 14-in. branch to supply the feed water heater, to the Utility muffler tank, from which connection is made through a Kieley back-pressure valve to the exhaust riser and through a 16-in. main to the heating system.

The riser to the roof exhaust head, having 320 ft. of 16-in. full-weight wrought-iron pipe, presented a difficult problem in its supporting. It is carried at the lower end by a drop leg below the inlet connection in the basement, which runs down to the boiler room floor and thus serves both as a supporting pedestal and a drip pocket. This carries the lower section of the pipe up to the eighth tier of floor beams or what is known as the second floor, where the line, together with the smoke stack, is offset 12 ft. for attachment to the middle wing of the upper structure for support. At this offset the line is rigidly anchored, above which the pipe expands freely to the roof, while below, expansion is cared for by a Walworth slip joint beneath the offset. This riser and the heating mains of 14-in. pipe and larger, are fitted with Van Stone joints, which are also applied in an extra heavy pattern for all high-pressure piping 6 in. in size and larger; all other piping has screwed flanged joints, corrugated copper gaskets being used throughout. Walworth valves are used throughout.

A number of systems of drip piping have been installed for the draining of the various systems of piping, both high and low-pressure, clean and dirty drip. The high-pressure steam mains are drained by a 3-in. line in trenches in the floor, which extends almost entirely around the building, making connection to all pockets in the mains where condensation may accumulate; the latter include all separators at engines, high pressure steam chests, and all branch connections above throttle valves. This line delivers normally to the feed water heater through an Anderson trap, but has also a connection to the blow-off tank, which will be used, however, only in emergency cases. All of the exhaust mains, low-pressure steam chests, and other steam mains in which the condensation may be fouled with oil are drained by a 5-in. drip line, also encircling the building in the trench, which has an outlet only in the blow-off tank. Still another line, principally of 3-in. pipe, is installed for delivering the snifting valve discharge from the engines to the blow-off tank. For the purpose of collecting the condensation returned from the heating mains, and cooking and heating apparatus of the house service, there are several groups of returns, ending in outlets on the ceiling of the



Details of Blow-off Tank with Cooling Coils.

lowest floor, from which points they drop to the trench and are led into the vacuum pumps. These lines make connection with the various Webster traps which drain the heating and low-pressure mains and also the hot-water heaters.

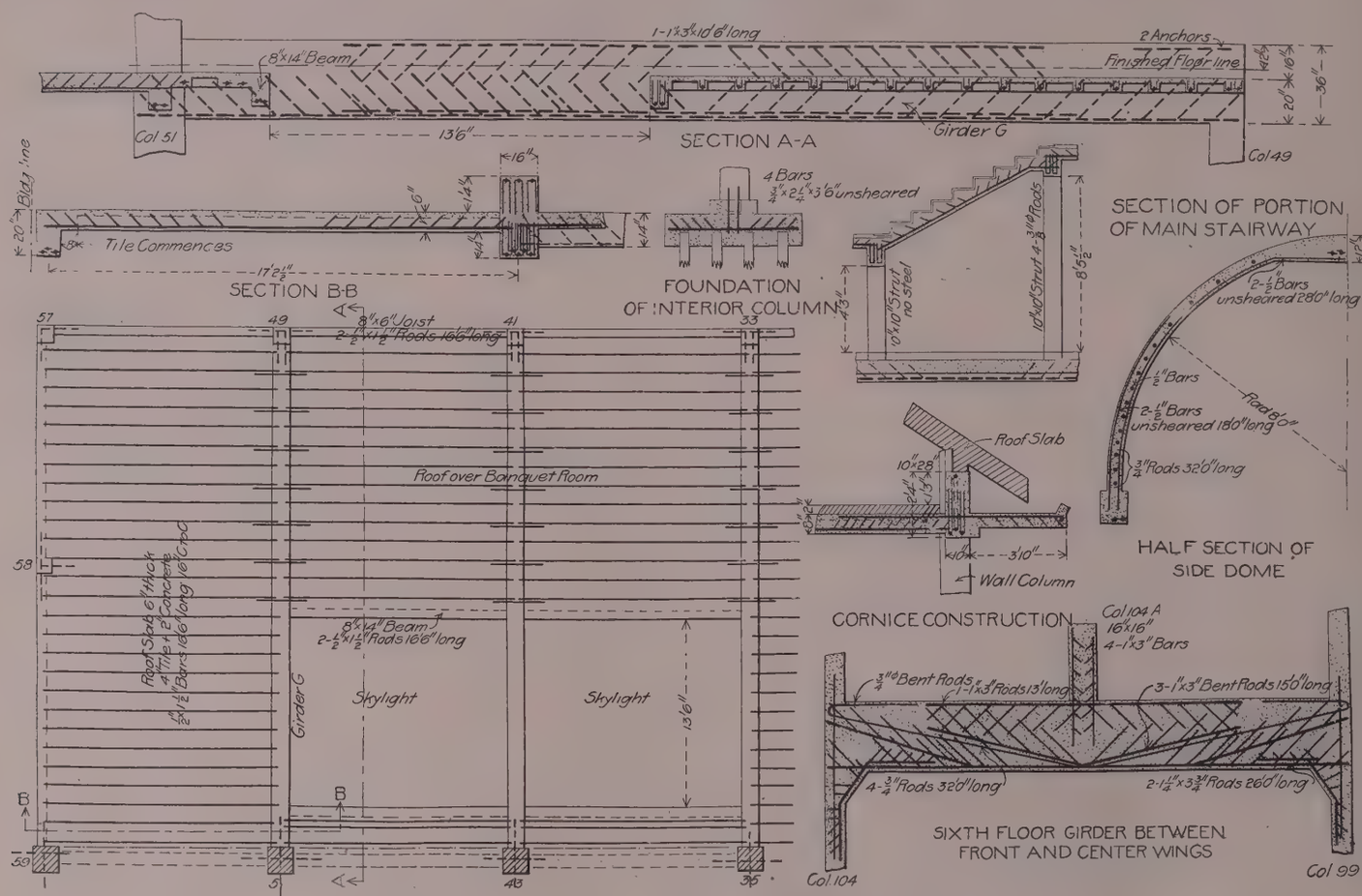
All of the steam piping has been covered with 85 per cent. magnesia sectional covering, one inch thick, put on with moulded fittings and an outside covering of 8 ounce white canvas duck, sewed on the pipe. The 10 and 16-in. headers, the muffler tank, feed water heater, blow-off tank, hot water heaters, and expansion tank are covered with magnesia sectional blocks, 1½ in. thick, put on over wire mesh so as to leave a 2-in. air space, the outside being covered with a coat of hard finish plaster. The smoke flues and connections are similarly covered, while the tops

Fitchburg four-valve construction, with double eccentrics for the independent operation of admission and exhaust valves, the governor controlling the action of the admission valves of both cylinders. The governors are of the centrifugal shaft type, providing for a long range of cut off, and regulate within 1½ per cent. The valve gearing of this engine gives results of the Corliss gear, a special cam motion giving prompt admission and rapid cut-off, while the cut-off is the only factor that is varied, the lead, release point and compression remaining constant at all points of cut-off. The valves are of a balanced-expansible double-ported piston type, giving close clearance.

An interesting feature of the engine installation is a special design of foundation with sand-

tain a uniform voltage with all increases of load, and are equipped for parallel operation. They all have overload capacities which will permit them to operate at 25 per cent. above rating for three hours without excessive heating. The distribution is to be handled upon the two-wire system, although the feeders have been arranged to permit operating them on the Edison three-wire system if it becomes necessary to use current from the Edison street service. The dynamos were built and installed by the Western Electric Co., general contractors for the electrical installation.

The power plant, as well as the heating system for the hotel, was designed and installed by Messrs. Baker, Smith & Co., heating and ventilating engineers, New York. The architects for the building are Messrs. Warren & Wetmore,



Roof, Dome, Girder, Stair and Cornice Construction, Hotel Marlborough, Atlantic City, N. J.

of the boilers are covered with two inches of magnesia plastic mortar. The casings of all tempering fans are, together with their ducts, covered with asbestos air cell covering, one inch thick, wired on and covered with 10-ounce canvas drawn tight. The coverings were furnished by the Keasbey & Mattison Co., and installed by the T. M. Valleau Co., New York.

Engines and Generators.—For the supply of electricity for lighting and power purposes a 750-kw. generating plant has been installed, which is of interest on account of the use of slow-speed apparatus. There are three units of 200 kw. and one of 150 kw. capacity, each consisting of a Western Electric Co. multipolar slow-speed generator direct-connected to a Fitchburg tandem-compound, heavy-duty, medium-speed engine. The engines are of the Tangye-frame, side crank type, the three larger units having 16 and 24 by 26-in. cylinders and, operating at 150 r.p.m. under a steam pressure of 115 lb., have a rating of 320 h.-p., while the fourth unit has 14 and 22 by 20-in. cylinders and, at a speed of 200 r.p.m., develops 225 h.-p. These engines have the usual

bed cushioning which was built as a precaution against possible communication of vibrations from the engines to the building frame work, a particularly desirable feature for a hotel building. The four engines rest directly on a single large monolithic block of concrete 4 ft. deep, which is calculated to initially absorb the motion of reciprocating parts. The sand cushion for insulating the latter from the solid rock underlying the entire building, consists of a bed 4 in. deep which was spread over the bottom of the excavation made for the foundation block; all around the edges where the block straddles building columns, piping, etc., there is an additional cushioning of 3 in. of sand. This construction has proved effective in accomplishing the desired result. The engine equipment, complete with the foundations, was installed by E. H. Ludeman & Co., New York.

The generators are engine-type multipolar machines direct-connected to their engines, and deliver direct-current at 120 volts. They are all compound wound, the overcompounding amounting to 4 per cent., which is calculated to main-

New York, while the general contractors are Messrs. Marc Eidlitz & Son.

(To be Continued.)

A Dredge Raising Operation was recently carried out in Montreal in an unusual way. The dredge was sunk in a collision, and settled in such a way that one side rested on the bottom and the other was above water. The current was too swift to allow divers to work and it was accordingly necessary to pull the vessel to the surface. To do this a large barge was moored on each side of the dredge and vertical timbers were run up from their side frames, making four rows of posts, over which heavy timber trusses were placed, the whole arrangement being like that of the steel framing of a three-aisle shop roof. Two threaded rods were then run down from the upper chords of each truss and chains connected with them and the dredge. By screwing up the rods, the vessel was gradually raised. When a rod was screwed up, the chain was held in place and the rod then dropped down again to take hold of a lower link.

Reinforced Concrete and Tile Construction in an Atlantic City Hotel.—II.

In most cases the floor girders have their upper surfaces in the same planes as the floors themselves, but at the first floor level there are in the rear wing of the building three special 16x36-in. girders of 36 ft. clear span connecting columns 33—35, 41—43 and 49—51 which project 14 in. below and 16 in. above the roof slab which they support and which forms a continuation of the floor slab. It is made like the floor construction, with 4-in. hollow tiles covered with a 2-in. layer of concrete and reinforced by ½x1½-in. bars 16 in. on centers and 16½ ft. long transverse to the beams, into the vertical faces of which they project slightly. The ends of alternate floor bars in adjacent panels are connected by continuity bars 6 ft. long laid close to them and passing directly through the floor girders about 1 in. below the upper surface of the roof slab. The falsework and mould for this girder was cambered 1¼ in. to allow for settlement and deflection during construction. After the removal of the falsework the girder retained a permanent camber of about 1 in. under dead load only.

Building Outer Walls with Hollow Tile.

In the first, second, third, fourth and fifth stories there are numerous balconies projecting from 2½ to 6 ft. beyond the faces of the exterior walls. The floors of these balconies are simple cantilever slabs, continuous with the main floors, without beams or reinforcing ribs. Their thickness varies with their span and they are made integral with the wall girders connecting the columns and supporting the outer walls, and they are anchored by reinforcement bars continued some distance into the main floors on the opposite sides of the walls.

The widest balconies have, however, in the planes of the wall columns, 6x18-in. cantilever beams integral with both column and balcony floor which are flush with the lower surface of the latter and project 6 in. above its upper surface as shown in the cross section and plan.

A portion of the main roof cornice is formed by an extension of the sixth floor beyond the outer walls under the eaves with a construction similar to that of the balconies. In this case the inclined roof slab is carried by a longitudinal 10x28-in. girder connecting the wall columns with its lower edge projecting 3 in. below the 10-in. sixth floor slab. The cornice projection is a continuous cantilever slab 6 in. thick, made with 4-in. tiles and 2 in. of concrete, and was built integral and simultaneously with the girder and anchored through it to the floor slab by extensions of the regular reinforcement bars in the latter. The upper surfaces of the wall girders were roughened and ⅜-in. round vertical dowel pins were set in it 32 in. apart and projected about 12 in. above it to engage the roof slab, which was built independently at a later date.

In each face of the rear wing a pair of first story wall columns enclose between them an architectural panel necessary to the motive of the building and support on their tops a 24x42-in. girder with a clear span of 8 ft. This carries in the center a 24x24-in. wall column six stories high, which has a maximum load of 260,000 lb. The girders are heavily reinforced with horizontal bars and bent bars, but the reinforced knee braces shown in the elevation were finally omitted in construction.

Above the sixth floor the pitched roof of the center wing intersects the vertical walls of the tower in the front wing and the framing is somewhat complicated. Some of the tower columns are not in line with the regular ones in the lower stories and are carried by special girders, connecting the latter. Column 104A, over the pitched roof, is carried at the center of an 18x40-in. girder which connects columns 99 and 104, 24 ft. apart. Especial care is taken to bond the different members by continuous reinforcing bars engaging both adjacent ones, as is shown by the vertical bars anchoring column 104A into the girder, and by the bent bars running from the girder through the knee braces into the lower columns.

The roof of the center wing is carried by the wall girders and by two lines of 10x24-in. longitudinal girders connecting the tops of the interior rows of columns. The ridge is in the axis of the building and transverse to it there are 10x20-in. and 10x18-in. inclined rafter beams about 12 ft. apart which run from the upper longitudinal beams to the eaves. All the beams and rafters are flush on top with the 6-in. roof slab of 1:2½:5 hard anthracite cinder concrete made without hollow tiles and reinforced with ½x1½-in. bars 16 in. apart on centers. The center panels of the roof are made without rafters and are 6-in. concrete slabs inclined in both directions from the ridge and acting like flat arches. In the plane of each pair of rafters there is at the haunches, just below the upper longitudinal girders, a horizontal ¾-in. round tie rod with the ends bent and embedded for 3 ft. in the upper part of the roof slabs.

Between the rafters there are large and small dormers. The ridges of the former are at the levels of the lower longitudinal roof girders which they intersect, and the circular roofs of the latter are about 12 ft. long and intersect the inclined roof slabs much nearer the eaves. Both dormers are made with continuous concrete slabs forming roofs and walls without beams or girders. In the large dormers there are ½-in. reinforcement bars 12 in. apart, parallel to the axis of the building. In the small dormers there are horseshoe-shaped ⅜-in. round rods 16 in. apart with one vertical leg in each side wall and the bent part in the curved roof. The dormers and main roof are covered with Spanish tiles, fastened with copper nails.

On one side of the building, in the center wing near the ocean end, there is a 7 ft. 4-in. x 11 ft. 9-in. fire escape tower extending from the lobby floor to the roof and containing a concrete stairway with landing at every floor. It has no openings into the building, but at each floor there is a cantilever balcony outside the building, which is accessible through a door in the wall of the building and another door in the wall of the tower.

All flights of stairs are made with solid reinforced concrete slabs having an inclined under surface between which and the vertical and horizontal faces of the upper surface there is a continuous mass of concrete, as if the steps had been cut out of the solid. The slab is reinforced by ½x1½-in. bars 16 in. apart bedded in the concrete parallel to and 1 in. above the inclined lower surface, with their bent flanges projecting upwards into the masses of concrete forming the steps. In the main stairs one edge is free of the wall and for architectural effect is provided with a closed stringer made integral with the slab and reinforced with a tension bar like an ordinary beam. These stringers are not required to carry loads as the stairs have, in all cases, ample strength independently. Landings between the flights are made with the standard tile and concrete floor construction. The risers have ½-in. cement finish and the treads are covered with marble slabs. In the ocean wing the main stairway leading from the lobby to the exchange floor occupies with its landings six sides of an octagon, and contains an open central well protected by a handsome massive baluster rail. A section of one flight and landings and the detail

of the step is shown in one of the accompanying illustrations.

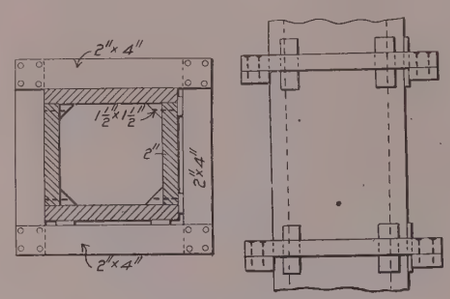
The outer walls everywhere are made with a single thickness of standard hollow tiles, 12 in. thick up to the first floor, and 8 in. thick above that level. They are laid in Portland cement and finished on the exterior with pebble dash in 1:1 Portland cement mortar. The inner surfaces are plastered on the faces of the tiles. The wall columns are flush with the outer face of the wall and project beyond the inner faces forming pilasters except where they are in the planes of partitions or pipe and ventilation conduits. The exterior ornamental work is made with terra cotta and the window casings are fireproofed throughout.

Construction operations were commenced June 26, 1905, when the site was cleared, contractors' offices and preliminary plant installed and the delivery of piles was commenced. Pile driving was begun June 27, and carried on vigorously until July 15. As fast as the clusters of piles were driven the sand was excavated rapidly, and without sheeting, to an average depth of about 6 ft. below the original surface, and the pile tops were cut off with hand saws 3 ft. below minimum ground water level. Concrete was filled in 12 in. below the pile tops to protect them from attacks of the teredo.

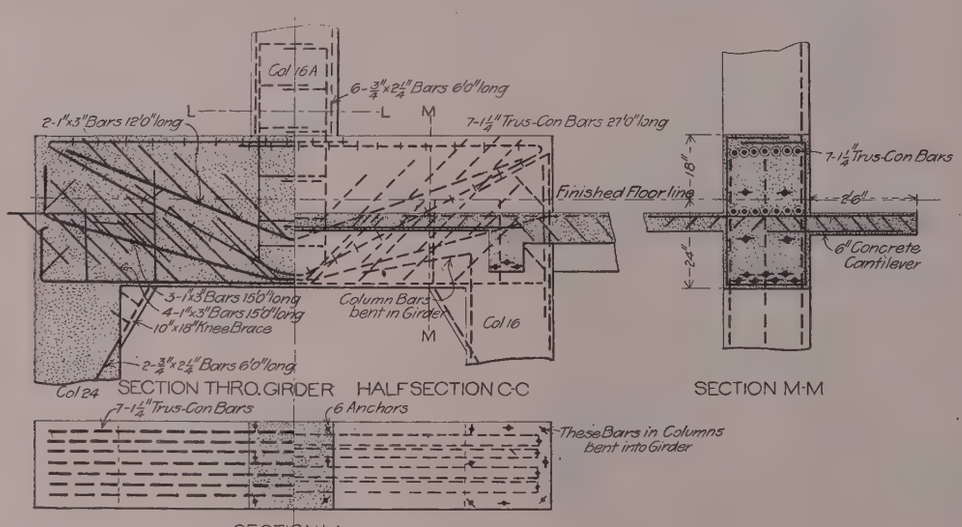
The two courses of stone concrete footings were built with the reinforcement previously described, and after they were sufficiently set the column moulds were assembled on them and the erection of the superstructure was commenced and prosecuted with great vigor.

At both ends of the building the vacant spaces reserved for the solarium now under construction and for the future kitchen in the rear, served for the storage of materials brought by teams from the freight station about half a mile distant. Vulcanite and Edison cement was stored in a weather-proof building with a capacity of 3,000 bags, and broken trap rock, sand and cinders were stored in heaps on the ground. The aggregate was wheeled by hand up inclines about 6 ft. high on opposite sides of the building and dumped into a Campbell and a Foote mixer, each driven by a steam engine. The concrete was mixed in ½-yd. batches and distributed by wheelbarrows on plank runways to the piers in all parts of the site.

Moulds for the columns, girders and floor slabs complete for one story were made at the site, the timber being cut with a circular saw driven by a 5-h.-p. Westinghouse electric motor which also operated one of the two duplicate concrete elevators with a pair of balanced platforms. All the column moulds for each floor were set up and the girder moulds were connected to them and supported by them and by intermediate vertical posts. Between the girders a level falsework platform for the hollow tile and concrete floor slab was laid and was supported intermediately by 3x4-in. vertical posts 4 ft. apart. The feet of these posts were knee braced in four directions and the tops were knee braced to the 3x4-in. transverse beams under the floor moulds. At the sides of the building 2x12-in. horizontal planks were nailed across the tops of several posts and projected beyond the outer walls to receive the knee braces for the sides of the wall girder moulds. The column moulds were made with 2-in. planed full-length vertical boards and had hand holes left in the bottom for cleaning and for placing the reinforcement bars. The truss bars projecting from the sides of the latter were bent horizontal at the ends of the bars and interlocking with those of the bars in the next column section below which projected into the bottom of the mould, were securely fixed in position at that point. At the tops of the moulds they were secured by horizontal strips temporarily nailed on.

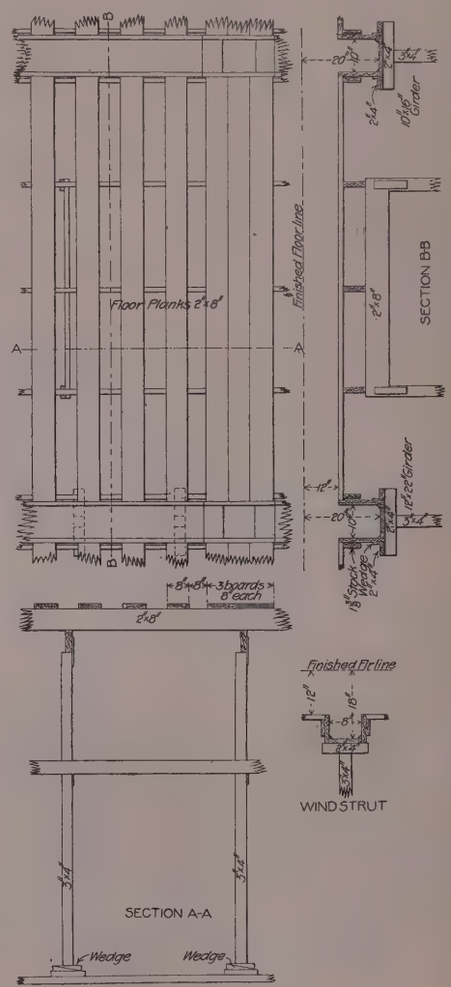


Mould for Column.



Girder Carrying Upper Stories of Wall Column.

The concrete made with ¾-in. broken stone mixed very wet and was delivered by the mixing machines to wheelbarrows, four of which at once were hoisted by an elevator adjacent to each mixer, and were wheeled on the girder moulds as tracks to the tops of the column moulds, which were first filled, and thoroughly puddled by long bars. Concrete was then spread 1½ in. thick over the bottoms of the girder moulds and the reinforcement bars were set in position. The remainder of the concrete was filled into the moulds and the rows of hollow tiles in the floor slabs were rapidly set. Wheeling track planks were laid across them and 1 in. of concrete was deposited in the spaces between the tiles. The reinforcement bars were set in position on this concrete and the spaces filled with concrete up to the tops of the tiles. Finally a 2-in. layer of concrete was spread over the tiles and formed a smooth, uniform floor space continuous over the column tops, and girders. Concreting in each story was commenced at both ends of the building simultaneously and carried forward to meet about at the center. Work was continued until 12 o'clock at night and care was taken to leave off on the center line of a girder where the continuity bars previously mentioned bonded the two sections together. Each floor contained about 30,000 sq. ft. of surface and was concreted in three days, a complete story being built and the falsework and moulds erected and taken down in two weeks. The supports under the girders and floor slabs were allowed to remain in position three weeks for the concrete to set thoroughly so that four complete full-story sets of falsework were required. The outer tile walls and the interior partitions were carried up as fast as the floors were built and the concreters were quickly followed by the plasterers, carpenters, plumbers, electricians and other workers so that no time was lost in the sequence of work.



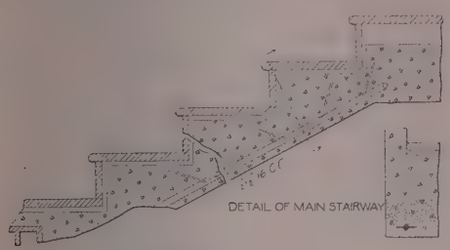
Centering and Falsework for Floors and Girders.

In building the roof the center longitudinal panel in the six-story part of the building was constructed of cinder concrete, and was made on a solid temporary board floor which served as a wheeling and distributing platform for the delivery of concrete for building the sloping sides first. The 1:3:6 cinder concrete here was mixed comparatively dry and stiff and was placed with trowels without requiring outside mould boards. The concrete in the upper and flatter center panels of the roof was built last.

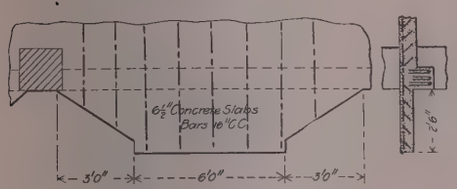
The building contains about 10,000 yd. of stone concrete, besides cinder concrete, 250,000 sq. ft. of hollow tile and 550 tons of reinforcement bars. About 500,000 ft. of lumber. B. M., were used for

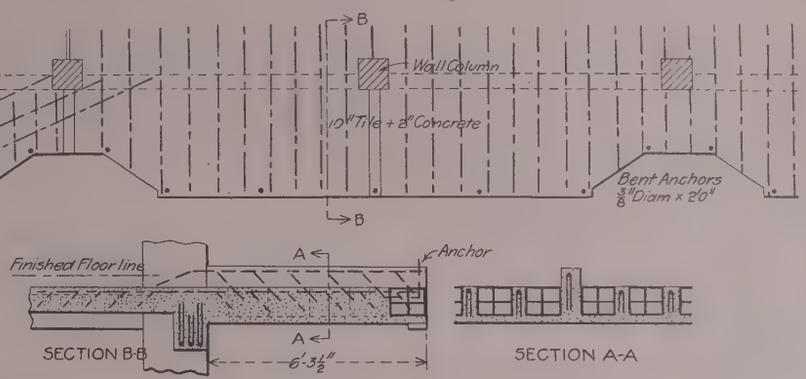
the falsework and moulds. Pile driving was commenced June 27; pier concreting July 4; column concreting, July 16. The roof was finished over the seventh story November 20, and the main dome will be finished in December. The main walls were completed up to the seventh floor November 10, and it is expected that the building will be ready for occupation March 1. A total force of about 300 men has been employed on the building since operations were fairly under way and the cost of the structure, ready for its equipment and furnishings, is estimated at $1,000,000 exclusive of the site.

Prince & McLanahan, Philadelphia, are the architects, and Edwin Gilbert & Co., Philadelphia, is the general contractor. The National Fireproofing Co., of Pittsburg, Chicago and New York, and Mr. H. M. Keasbey, vice-president and manager, and Mr. E. E. Nickson, Philadelphia, manager, is the contractor for the work here described, which was executed under the superintendency of Mr. James L. Costello. The structural designs and details were made by the Trussed Concrete Steel Co., Detroit, Mich. Mr. M. Goldenberg, chief engineer; Mr. M. Kahn, New York, manager, and Mr. B. J. Green, head resident engineer, under whose direction the reinforced concrete hollow tile construction was designed. The building is owned by the Annex Co., Mr. J. J. White, president.

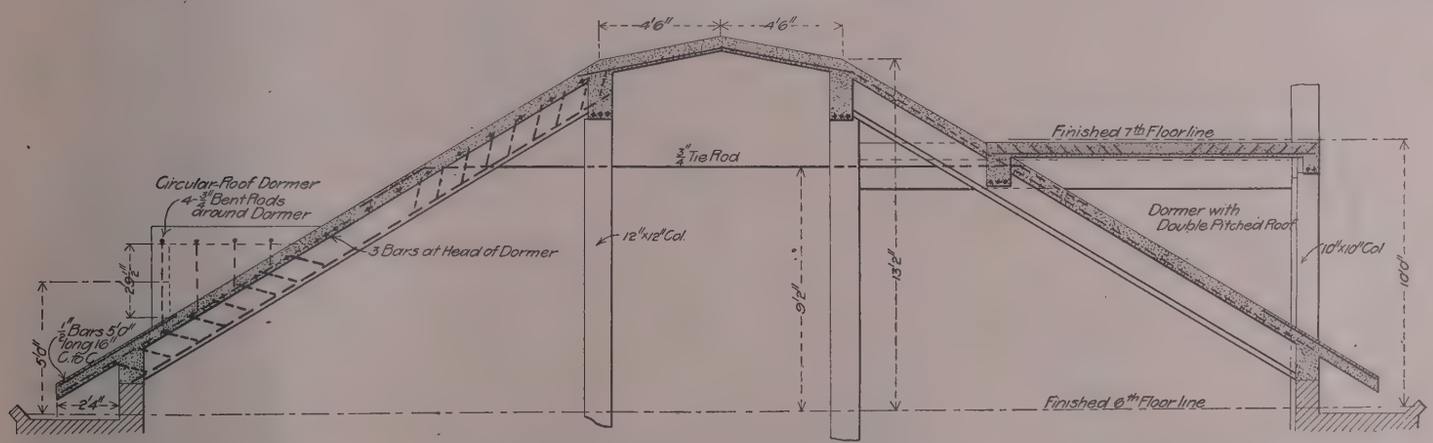


Concrete Stair Construction.





Construction of Cantilever Balcony.



Typical Cross Section of Roof in Center Wing.

AN EXTRAORDINARY LOW TEMPERATURE—271° Cent., which is very nearly down to absolute zero, was recently attained, according to "Engineering," in an attempt by Prof. Olszewski to liquify helium, He suddenly expanded a mass of the gas compressed to 180 atmospheres and cooled to the temperature at which hydrogen is on the point of solidifying. The gas showed no signs of liquefying even at the extreme cold thus attained.

Rapid Transit Subway Construction on Fulton St., Brooklyn.—II.

The double-track viaduct of the Brooklyn elevated railroad follows the center line of the Fulton St. subway for about 2,600 ft. and about 96 of its vertical columns, 14 to 22 ft. high, 45 ft. apart transversely and 50 ft. apart longitudinally are located within the limits of the subway and have to be eventually supported permanently on the subway roof as described in a previous article. During the construction of the subway these columns are carried on temporary supports which are so efficient that they are put in place, erected and adjusted without interrupting the elevated or street traffic or interfering with the excavation. The general features of these supports were described in a previous article, but as some details have been changed and important modifications have been made since, the present system is here described in full,

Before the general excavation and street decking already described is commenced 5x8-ft. pits 10 ft. each way from the column on its longitudinal center line, are sheeted down to subgrade. Sections of the 6x12-in. floorbeams are laid in the bottom and a pair of short 12x12-in. yellow pine vertical posts are set on them. They are capped by the end section of the 6x8-in. lower cross strut marked *D* in the diagram of excavation and timbering of the subway trench. This cap also serves as a sill for the upper sections of the posts, which are capped at street level by 12x12-in. braces made with short sections of transverse 6x12-in. pieces, butt-jointed and spliced with bolted side planks. The longitudinal braces are also sectional, so that the end lengths can be assembled with the posts in the pits and afterwards spliced to the braces in the trench.

The upper transverse caps are double 6x12-in. timbers 12 in. below the cut and support pairs of 6x12-in. longitudinal pieces, *B*, 22 ft. long, bolted to them flatways, in the planes of the vertical posts. On these longitudinals are seated the horizontal faces of the beveled lower ends of double pairs of 12x12-in. timbers, *C C*$_1$, forming the double A-frames which support the elevated railroad structure. The upper ends of the inclined posts take bearing at the top of the permanent steel column and the lower ends are drawn together by horizontal tension bars so as to secure a toggle action and slightly raise the top of the elevated column and its connected transverse girder and transfer the load of the structure and trains to the A-frames and their supporting vertical posts in the pits. The steel column is thus suspended while its old foundation is undermined, lowered clear of the column base, blasted into small fragments and removed during the course of the trench excavation which follows some time after the adjustment of the A-frames.

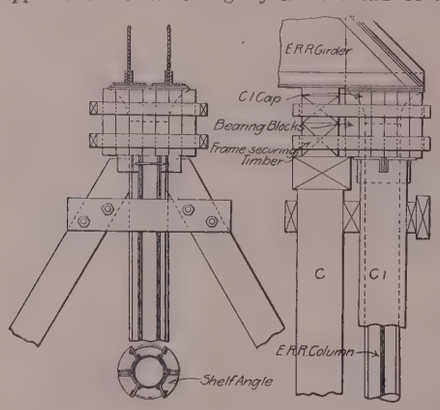
As soon as the upper cut of the trench excavation is made the vertical posts under the inclined posts of the A-frames are connected by a 6x12-in. horizontal longitudinal tie bolted to both posts and to the lower transverse tie, thus completing their bracing in both directions. After the removal of the old column foundation a vertical 12x12-in. post in two sections, separated by the transverse horizontal brace in the trench timbering as are the posts under the A-frame, is wedged to bearing under the column pedestal to give it direct support and supplement the A-frames. A 10x12-in. inclined transverse brace from the steel kneebrace at top of the column to the first longitudinal timber under the roadway deck virtually transforms the A-frame to a tripod and provides rigid bracing to the elevated railroad structure, which has in no case on this work shown any lack of stability or visible vibration under the traffic of frequent fast and heavy trains.

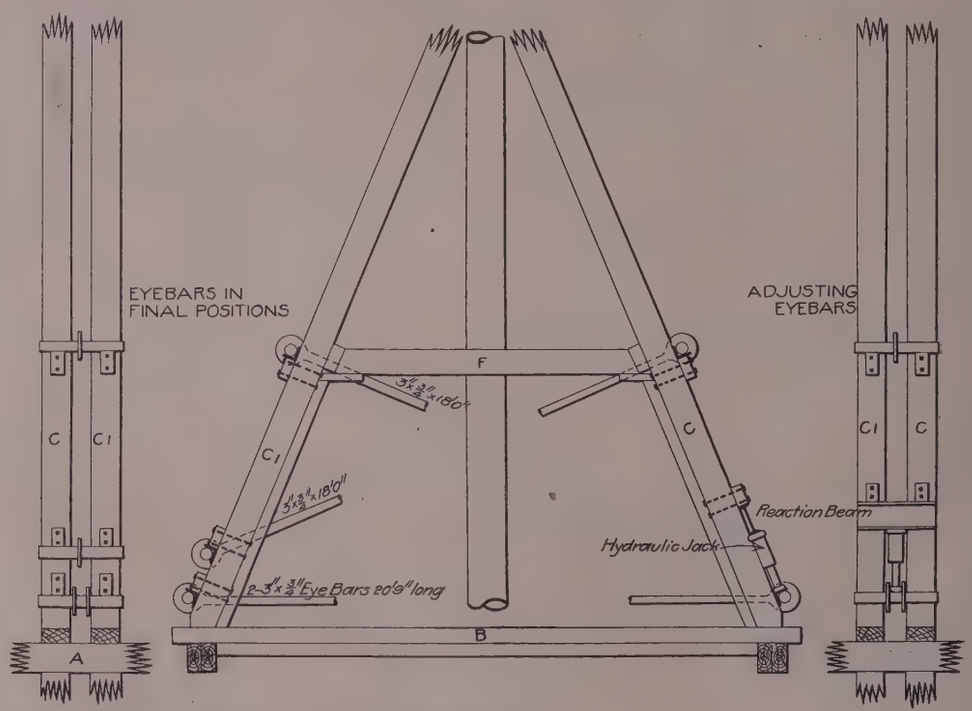
The details of the A-frame, its connections and methods of adjustments have been improved since the beginning of the work and are interesting and ingenious. The elevated railroad columns have an internal diameter of about 11 in., are made up

with six Phoenix sections and are capped with a cast-iron pintle having an extended flat top on which is seated the bottom flange of the transverse lattice girder. This design does not afford any connection for the underpinning, therefore temporary bearing for the A-frame was provided by bolting to the column about 2 ft. below the top, two pairs of flanges made from short lengths of 8x8x½-in. angles bent as shown in the detail to fit the column web and flanges and secured by one rivet through each vertical flange of the angle and through a hole made by cutting out one rivet in the column flange.

The bevelled upper ends of two of the A-timbers are slotted to clear the column flanges and are capped with a pair of short horizontal transverse beams which are supported at their opposite ends on the tops of a longitudinal cap connecting the tops of the other pair of A-timbers, just inside the column. Short vertical timbers are fitted between the transverse caps and the top plate of the column cap and a transverse timber is wedged between the caps and the lower flange of the transverse lattice girder, thus providing a solid bearing between the elevated railroad structure and the tops of the A-timbers.

Two 3x¾-in. horizontal eyebars are assembled between the pairs of A-frames about 1½ ft. from the lower end, so that their pins, resting against the inclined upper surfaces of the A-timbers engage the plunger of a 10-ton hydraulic jack reacting against a 4x4-in. solid steel bar 9 in. long, which is bolted to the upper surface of each A-timber about 4 ft. from the lower end. The jacks being set between the A-frames clear the eyebars and as they are operated force the pins down along the inclined surface and develop tension in the eyebars, pulling the feet of the A-timbers together and correspondingly raising their upper ends so as to slightly lift the end of the transverse lattice girder and steel column. When the adjustment is completed a second pair of 4x4-in. reaction blocks are bolted to the A-timbers in contact with the ends of the pins and lock the latter in position while the jacks are released and their reaction blocks shifted so that they can be operated again in exactly the same manner to stress a second set of diagonal eyebars above the first set which truss the A-frame and serve also as safety bars to compensate for any deficiency in the horizontal bars.





Details of Shears for Supporting Elevated Railroad Columns.

It is of course difficult to divide the stress equally between the two sets of bars and the diagonals are merely put under snug tension, and so that they will take up the stress before any material displacement occurs if the lower horizontal bars fail. During the operation of the jacks the lower ends of the A-timbers are sledged to make them slide easily on their longitudinal sill timbers. After the eyebars are adjusted the A-frames are braced by horizontal timbers at the level of the upper ends of the diagonal bars, and other braces are added if necessary. It usually requires four men working 10 hours to erect and adjust the A-frames for one column of the elevated railroad. Some of these frames have been in service over three months and seldom or never require any attention except regular inspection after the first adjustment.

The excavators are followed closely by the concreters, who usually keep about 100 ft. behind the finished excavation and in sections where the full four-track construction is being built at once; first, simultaneously place strips of the floor about ⅓ on the full width and about 25 ft. long on each side, reaching from the outer wall to a little beyond the side columns, and providing footings for the walls and the two rows of side columns. After the concrete is set the water-proofing for the lower part of the outside walls is put in place, the moulds are built to a height of about 6 ft., two men erect the reinforcement bars and the side wall concrete is built up to a height of about 6 ft. above the base of rail.

After the floor concrete has set four days the double spoil tracks are shifted from the bottom of the trench on the center line and one track is laid on the permanent concrete floor on each side of the tunnel close to the outer wall and the third section of concrete is laid completing the permanent floor and including the footings for the center columns. The fourth sections of concrete are then laid in the side walls reaching from the first to the second tiers of horizontal transverse struts and the three longitudinal rows of columns are erected.

Moulds for the flat roof arches or slabs are then blocked up from the longitudinal channels and from the transverse struts and the roof is completed in transverse strips 5 ft. wide, alternating with open spaces of the same width. These strips clear the vertical posts of the trench timbering, which are carefully located 10 ft. apart in the centers of the open spaces, and they enclose one-half of each permanent steel column. This concrete is placed without disturbing any of the timbering, the vertical posts supporting the I-beams under the street and car tracks being left in position with room between them for the 5-ft. section of concrete.

After the concrete is about 4 days old the supports of the street deck and tracks are transferred to it, the transverse trench bracing in the alternate open spaces is also shifted to bear against the finished side walls and the subway is completed by filling in the roof concrete in the 5-ft. open panels between the finished sections. All the concrete is hand mixed, 1:3:4, with Giant Portland cement and on each roof slab work is prosecuted continuously from the time it is commenced until it is completed.

The ties for the street tracks are blocked up on 4x8-in. longitudinal timbers supported by vertical posts or blocking on the finished subway roof and the water-proofing is completed as the posts are shifted and the holes they leave in the roof are filled with brick and mastic.

The concrete is water-proofed with a single thickness of tar paper and bricks laid in hot asphalt and finally the trench is back-filled with earth flushed in with plenty of water, but not rammed, and the permanent paving is restored. The longitudinal timbers and blocking under the car tracks are left in position to prevent the possibility of settlement while the fill is new. This is believed to be the first instance in which the subway construction has been built in alternate full-width concrete strips, and the results are considered very satisfactory, the joints between the successive sections made at different times being smooth and accurate and the work being carried on steadily and rapidly with economy of labor and materials. The timbering is moved forward to the excavating heading as fast as the concreting is completed and is used again and again without cutting, each piece being marked and used in the same relative position every time. All the operations are made with uniform speed, which is limited by the rapidity with which it is possible to complete the excavation, and with the present force of about 125 men working one 10-hour shift is about 125 ft. a month of 4 four-track section, which involves an excavation of about 58 cu. yd., 10 yd. of concrete and 2,000 lb. of steel per lin. ft.

The forms or centering for the concrete roof arches substantially resemble those illustrated in The Record of October 22, 1904, but differ from them in detail. Each is 6 ft. long and 12½ ft. wide with the ends curved to a radius of 24 in. and a flat upper surface. Each has three ribs covered with 2x1¾-in. longitudinal lagging nailed close around the haunch. Each rib is made in two 9x1¾-in. pieces with a joint in the center of the span, but instead of having a bolted lap joint as in previous work these ribs have a butt

joint with longitudinal face strips connecting the ends of the ribs on each side and separated by fillers and wedges which provide a means of rapid adjustment and for the striking of the centers.

The work is being built to the plans and specifications of New York Rapid Transit Railroad Commissioners: Mr. George S. Rice, chief engineer; Mr. Alfred Craven, deputy chief engineer; Mr. Frederick C. Noble, division engineer; Mr. Svere Dahm, general inspector of designs, and Mr. Lazarus White, engineer in charge. The contractor is the Rapid Transit Subway Construction Company: Mr. George H. Pegram, chief engineer, and Mr. Percy Litchfield, division engineer of section No. 3. The sub-contractors for this section are Messrs. Cranford & McNamee, Mr. W. V. Cranford, Mr. John McNamee and Mr. F. L. Cranford, active partners. Mr. F. L. Cranford has charge of the work, assisted by Mr. J. C. Meem, chief engineer. Mr. Howard Robinson is superintendent of the Fulton St. division.

Shears used for Supporting Elevated Railroad Columns.

A COLUMN OF POROUS TILE of the Hobart partition form was tested some time ago in the laboratory of the National Fire Proofing Co., Chicago. The tile were laid in good brick mortar to which a little cement had been added, and the column was 12 ft. 3 in. high, 3 ft. wide and 4 in. thick. No indications of failure were given until a load of 20 tons had been placed on it, when a slight buckling was observed at the center. At 22½ tons buckling increased, and failure occurred at 34 tons, or 477 lb. per square inch.

Concrete Construction for the B. T. Babbitt Works.

The new B. T. Babbitt plant for the manufacture of soap is located on the line of the New York, Susquehanna & Western R. R., about nine miles from Jersey City, N. J. It occupies low flat land near tide water and the fourteen principal buildings are arranged in two rows separated by a street with which their axes are perpendicular. They are close together within an area of about 400 ft. wide and 900 ft. long, and their principal dimensions are as follows: Printing and box factory, 50x200 ft.; box shop, 50x200 ft.; potash and can building, 60x200 ft., two stories high; soap powder building, 60x127 ft., one and two stories; soap building, 150x200 ft.; kettle building, 50x200 ft., four stories; glycerine building, 60x200 ft., three stories; power house, 76x164 ft.; resin house, 50x140 ft., one and two stories; soda, ash and lime building, 50x120 ft.; tallow storage, 120x120 ft., one and two stories; general storage, 110x210 ft. Except as above mentioned, the buildings are one story high, and all of them have pile foundations, concrete substructure, and brick and steel superstructure.

The piles are driven in clusters, capped just below the surface of the ground and surmounted by pyramidal concrete piers which carry the outer walls, columns and floors. They support the steel I-beam girders, usually about 18 ft. long and 9 ft. apart and 6 ft. above original ground level for the first floor. These beams are entirely enclosed with concrete and carry a concrete floor slab 5 in. thick in most cases, reinforced by expanded metal. The space under the first floor is vacant but is enclosed by the outside walls, which, from about ground level to the first floor, are vertical concrete slabs 13 in. thick, acting as deep beams, virtually clear of the ground, supported on the wall piers and carrying the 12-in. brick walls from the pile footings. Between the concrete and the brick wall there is interposed a water table course of cement blocks made with 1:2 cement mortar cast in moulds at the site. The roofs for the one story buildings are supported on the outer walls and by interior columns 12 or 15 in. square and 16 ft. long, made of reinforced concrete and anchored at the base with four ¾-in. round vertical rods embedded in the pier concrete and projecting about 2 ft. above the floor. In the power house the steel roof trusses carry hand mixed cinder concrete slabs; elsewhere all the roofs are made with plank sheathing and are usually carried on steel I-beams. The construction is very simple and ordinary methods were used throughout.

Trap rock broken to ¾-in. was received in gondola cars holding about 30 cu. yd. each and was discharged and shoveled into a track hopper adjacent to the concrete tower on one side of the plant near the end of the row of buildings. A gate in the hopper delivered the stone to a bucket elevator, which raised it to the top of the concrete tower. Several cars of stone were received daily from Francisco Bros., Little Falls, N. J., and were unloaded in about 1½ hours each, the track hopper not being large enough to receive a full carload

Sand from the New Jersey Woolen Mills, at Garfield, N. J., was received and delivered in the same way. The upper part of the tower was divided into three storage bins with bottoms sloping down away from the elevator. The center bin was used for sand and the side bins for stone, which was deflected to either by means of a movable chute.

Two rectangular holes about 1 ft. square were cut through the vertical front side of the sand bin at the foot of the inclined bottom and one hole in each of the stone bins. These holes were fitted with gates consisting of steel plates curved to segmental cylindrical surfaces about 3 ft. in diameter with horizontal axes parallel to the front wall of the bin. Each plate was stiffened by a pair of 2x2-in. angles bent to V-shape and riveted to the plate in vertical planes near the ends. One leg of each V was curved to fit the cylindrical surface and the other leg formed a rigid operating link attached at the vortex of the V to the upper end of edge of the gate plate, and at the lower end intersecting the axis of the cylinder, where it engaged a horizontal ¾-in. square rod about 4 ft long, journalled at both ends and furnished with a lever by which the gate could be revolved on its axis, opening or closing the aperture in the bin with the minimum resistance from the sand or stone. These gates were operated by hand from a platform over the top of two measuring hoppers in front of the concrete tower, into which the contents of the bins were delivered, one sand gate and one stone gate for each measuring hopper.

Lehigh Portland cement in bags was delivered by hand to the measuring hoppers and the contents of the latter were discharged through bottom chutes to steel funnels attached to a pair of Smith concrete mixers set on the front side of the measuring platform at a lower level. The measuring hoppers were each provided with a short steel spout to which was pivoted, with a horizontal axis, a steel trough or chute. Normally the chute was revolved upwards and secured by a hook, thus effectually closing the spout and retaining the contents of the hopper.

When the mixing machine was ready to receive a charge, the hook was disengaged from the chute

and the latter, revolving downwards, formed a continuation of the bottom of the spout and delivered the contents of the hopper to the funnel, which at the same time received water through a valved pressure pipe. The concrete mixing machine could be revolved to discharge its contents directly into 1-yd. steel side dump cars with V-shape boxes mounted on high longitudinal axles on narrow gauge trucks. Four of these cars were used and ran on a portable railway. The track was a little above the first floor level and was carried the full length of the row of buildings on wooden towers about 10 ft. apart, which supported two lines of 4x10-in. planks slightly farther apart than the track rails, which received the ends of the steel cross ties. Lateral branches were taken from this track and passed through the principal buildings; the cars were pushed by hand to the required positions and their contents dumped into the moulds for the piers and for the walls.

After the completion of the piers and walls falsework was built for the floor slabs and the expanded metal reinforcement sheets were placed on it. Service tracks were laid to permit the concrete to be delivered in the dump cars, and the floor slabs were made in sections as indicated in the accompanying engraving. After the completion of the first floors, column moulds made of four vertical planks secured by horizontal cross pieces bolted together, were set up over the dowels and were firmly braced by inclined struts. Light movable wooden towers with upper working platforms were moved from mould to mould, and men working on top of them filled the moulds with concrete hoisted up in ordinary water buckets by hand lines.

Above the first floors the brick walls and roofs were built in the usual manner; the buildings more than one story high having steel interior columns and steel beams for the concrete upper floors. Platform elevators of the ordinary double-balanced type were provided for hoisting concrete and other materials to the upper floors. The concrete mixers and the sand and stone elevator were operated by a steam engine under the storage bins which was supplied with steam from an adjacent vertical boiler. About 100 cu. yd. of concrete was mixed daily.

Work was commenced on the piers about May 1 1905, and it is expected that the roofs will all be on during January if the weather is favorable. Pile driving was commenced in the spring of 1904 and about 11,000 piles were driven by Rhodes & Manvel, Elizabeth, N. J. There are about 12,000 yd. of 1:2:5 concrete in the buildings and nearly all of it is now in place. The buildings were designed by Mr. W. A. Aiken, mechanical engineer for the B. T. Babbitt Co. The John W. Ferguson Co., Paterson, N. J., is the general contractor, Mr. A. E. Schneeweiss, engineer, and Mr. O. Matthews, superintendent.

General View of Site, Showing Concrete Tower and Concrete Track. B. T. Babbitt Works.

A Three-Hinged Arch of concrete has recently been built near Halden, Westphalia, forming the center span of a highway bridge having an 18½-m. concrete span at each end. It has a clear span at 25 m., rise of 3¾ m. and a thickness of 0.5 m. at both crown and abutments. The concrete for the arch was a mixture of 1 part Portland cement, 4 parts sand and 6 parts broken stone. The hinges were blocks of 1:2:2 concrete, made by running a very dry mixture in wood moulds with the curved surfaces formed of plaster of paris. Lead plates 2 mm. thick were placed between the bearing surfaces and protected on each side by very thin sheets of brass. According to "The Engineer" of London, the hinges are found to work satisfactorily.

Government Contracts; Legal Pitfalls and How to Avoid Them.—III.

By George A. King and William B. King, Members of the Bar of the Court of Claims.

Powers of Engineer.—Government contracts involving constructive work usually grant a wide measure of discretion and authority to the engineer officer in charge. The following provisions, taken from a river improvement contract of the War Department, are fair examples of such powers:

"The decision of the Engineer Officer in charge as to quality and quantity shall be final."

"The Engineer Officer shall have the power to prescribe the order and manner of executing the work in all its parts, to forbid the use of methods which he deems objectionable and to inspect and reject materials, work and workmanship, which in his judgment do not conform to these specifications or to the drawings which may be furnished from time to time."

Contracts for supplies, stores or material of any kind usually contain a corresponding provision in regard to the inspection of the material delivered. The following specimen article of such contracts is taken from a contract with the Commissioner of Indian Affairs:

"All goods or supplies offered for acceptance under this agreement shall be inspected by the samples thereof submitted with the proposal by persons properly designated for that purpose by the party of the first part, and at such place as he may designate; and if on such inspection any of the said goods or supplies shall fail to conform to or to equal said samples the same shall be rejected."

These powers conferred upon the engineer or inspector by these provisions are very broad and

numerous cases have come before the courts where hardships have resulted to contractors from unfavorable decisions under them. The engineer or inspector being an officer of the government, one of the parties to the contract, it has been questioned whether such provisions can be sustained in law, since in effect they make one of the parties a judge in his own cause. The rule is now well settled that the courts will sustain them as the deliberate expression of the will of both parties to the contract. The parties fix the rule and the courts will carry out their intent, however broadly the powers be conferred on the engineer or inspector. Good faith and an honest purpose in exercising these powers will be enforced by the courts, and they will limit the scope of such discretionary powers strictly to the express terms of the contract and will not extend them any farther than its words express.

Discretionary Powers Sustained.—The consideration of actual cases will show the circumstances under which the courts have sustained these discretionary powers and will also define the limitations which have been enforced upon them.

One of the most extreme of all these cases was one of the first decided on this point by the Supreme Court of the United States, in 1878. A contract was made for transporting military supplies from points on the Kansas Pacific Railway to various posts in the West. The contractor was to be paid according to distance and the contract provided for "the distance to be ascertained and fixed by the Chief Quartermaster of the District of New Mexico." The Chief Quartermaster, when called upon to ascertain and fix certain distances, fixed them at less than an air line between the points. The actual distances by road were slightly longer. The contractor claimed pay for the difference between the distances fixed by the Quartermaster and the shortest road. The Supreme Court declared that under the language quoted, the Chief Quartermaster's decision was final. As the contract plainly stated that the distances should be fixed and ascertained by him, the court said that his decision, even if mistaken, must control, adding "His action cannot, therefore, be subjected to the revisory power of the courts without doing violence to the plain words of the contract." Accordingly the contractor received pay for a shorter distance than the air line between the points. The court admitted that the correct distance might be established if it was shown that "fraud or bad faith" existed, or that the officer "did not exercise the authority given him with an honest purpose to carry out the real intention of the parties." This extreme case illustrates the danger of all provisions granting so great discretion to any representative of one party.

The principle asserted in this decision is the broad rule that parties who make contracts must be bound by them. Its application is of very wide range, affecting equally all contracts either for public works or for furnishing supplies when they contain provisions like those quoted above. It has been enforced by the Supreme Court of the United States in a wide range of later cases.

A contractor for building a brick wall agreed that the wall should be received when a designated officer had certified that it was in all respects as contracted for. That officer refused the certificate and the contractor was obliged to sue for his pay. He alleged that the wall was properly built, but the Supreme Court refused to consider this question at all. They said that the refusal of the officer to give the certificate, since that was the test created by the contract, defeated the claim, in the absence of fraud or like fault.

The same doctrine was applied by the Supreme Court in a case between a railroad company and a contractor. There the contract provided that the company should pay when the work was completed and certified by the company's engineer. The engineer refused to certify the work and the company refused to pay. The contractors sued the company, without alleging fraud or similar fault on the part of the engineer. The Supreme Court held that without the engineer's certificate the contractor could not recover, saying: "Neither party reserved the right to revise that determination for mere errors or mistakes upon his part. They chose to risk his estimates."

The same question came up in an opposite application a few years later in another railroad case. The contract contained similar provisions and the work was certified by the engineer and payments made. Upon a recalculation by the railroad company they determined that the engineer had certified to excessive quantities and sought to deduct the excessive payments from sums subsequently due for later work. The Supreme Court declared that both parties by their contract had declared the certificate of the engineer to be binding upon them and that the railroad company in

Distributing Track and Reinforcement for Concrete Floor Slabs, B. T. Babbitt Works.

this case, just as the contractor in the previous case, was bound by this stipulation of the contract, notwithstanding the errors.

A contract was made with the United States for a large amount of rock excavation in the Louisville and Portland Canal, near Louisville, Ky. The contract provided that in case of delays by force of the elements, such additional time for completing the contract might be allowed as in the judgment of the engineer officer in charge "shall be just and reasonable." The contractors proved that their delays were not their own fault, but were due to the force of the elements. They claimed that the court had a right to revise the action of the engineer officer and to declare them entitled to an extension, although this had been refused by the engineer. The Supreme Court declared that the contractors had subjected themselves by their own agreement to the decision of the engineer officer and refused to give them any relief. The Court of Claims and three judges of the Supreme Court, including the very judge who had delivered the opinions in two of the cases already cited, took the opposite view of this case. They did not deny the general principle that the decision of the engineer officer is final when the parties agree that it shall be, but drew a refined distinction between the language of this particular contract and that used in the contracts construed in the other cases. This illustrates the tendency of judges to construe these provisions strictly.

The Court of Claims decided another similar case at its last term. Certain stone had to be furnished under a contract for constructing locks on the Illinois River. The specifications contained the provision that all materials furnished should be subject to a rigid inspection and made the decision of the engineer officer final as to quality. The Court of Claims held that they could not look into the quality of the stone, but were bound by the decision of the engineer officer.

Void Exercise of Power.—While the Supreme Court has sustained, as we have now seen, the right of the parties to a contract to vest discretion in any officer whom they may select, it has recognized that the parties intend some limitations upon this discretion and has therefore set boundaries to it.

In one of the cases cited, the Supreme Court, as has been seen, declared that there was "no proof of fraud or bad faith," and nothing "to justify the inference that the officer did not exercise the authority given him with an honest purpose to carry out the real intention of the parties." This implies that had fraud or bad faith, or a lack of such honest purpose been shown, the contractor would not have been bound by his decision.

In another case the Supreme Court stated the rule that "Fraud or mistake so gross as to necessarily imply bad faith," will impeach the decision of the officer. In still another case the Supreme Court said that the parties "did not intend to waive the demand that the engineer should at all times and in respect of every matter submitted to his determination, exercise an honest judgment, and commit no such mistakes as, under all the circumstances, would imply bad faith.

The Court of Claims, using a somewhat different form of expression, said that "bad faith or the exercise of capricious and wanton power upon the part of the engineer in the annulment of a contract vitiates such annulment." In another recent case the Court of Claims stated the conditions under which the exercise of the discretion of the engineer can be attacked, saying: "If the officer in charge had acted in bad faith in requiring the performance of the work at such times, and under such circumstances, as to indicate a tyrannical and fraudulent exercise of power, in that case the rights of the claimants in this proceeding would be materially different."

All these different expressions seem to involve the same idea, that the parties intend that the officer's discretion shall be exercised honestly and on a reasonable basis. When he fails to do this the conditions imposed by the terms of the contract have not been met, and the courts will then relieve the contractors from the consequences of such unjust exercise of power.

An instance of this occurred in the contract for engineering work upon the St. Mary's Falls Canal in Michigan. It was there provided that pumping should be done by the United States to free the lock pit from water during excavation, the contract saying: "For this purpose the engineer in charge will locate the position and determine the dimensions of all necessary wells." The engineer located but one well, at an extremely inconvenient point, and the contractors, in order to do their work, themselves located and dug additional wells. They sued for the cost of these wells. The Court of Claims held that the action of the engineer was unreasonable in refusing to locate more than one well, and was not an exercise of reasonable discretion under the contract. Judgment was rendered in favor of the contractors for the expense thus incurred.

No Discretionary Power Implied.—In most cases where relief has been granted from the acts of engineers or inspectors, it has been on the ground that the particular act complained of was outside the discretionary powers expressly conferred upon him by the contract or was not exercised in the manner provided by the contract.

The courts have repeatedly held that these extraordinary powers vested in the engineer by such provisions as we have quoted must be directly limited to those matters which the parties in terms have confided to the engineer. The courts will not extend such powers by implication, but will determine on its merits every controversy which the parties have not expressly placed by the contract in the hands of some selected engineer or inspector. This general rule of law has been followed strictly by the Court of Claims in its interpretation of government contracts.

Thus, in a contract for work on one of the Mississippi River levees, authority was given to the engineer in charge to annul the contract by notice in writing. The notice was in fact signed by the assistant engineer in the absence of the engineer in charge. The Court of Claims intimated that this exercise of authority could not be delegated, but must be strictly followed or the act would be void. It is true that this case was actually decided on another point, but the court's view was plainly expressed on this point.

In erecting the Post Office Building at Washington the contract provided that if any work or materials were omitted or added there should be a deduction or addition of price at market rates, which "in case of dispute are to be determined by the supervising architect, whose decision with reference thereto shall be final." Vermont marble was required by the specifications and for this, by consent of the Secretary of the Treasury, Tennessee marble was substituted. The supervising architect fixed a price which the contractors said was too low. They sued in the Court of Claims for a higher price. The government relied upon this provision of the contract. The Court of Claims said that the power of the supervising architect was strictly limited by the terms of the contract; that this authorized him to fix the value of materials in case of omission or addition, but not in case of substitution. The discrimination is very close and illustrates in a striking way the principle that the powers of the engineer or inspector will be limited exactly to the express terms of the contract.

In the construction of the Puget Sound Dry Dock the contract gave power to the engineer "from time to time during the progress of the work to inspect all material furnished with full power to reject any material." The engineer first in charge approved a certain quarry and the contractors, at the time when he was superseded, had not only delivered a considerable quantity of stone, but had cut other stone in the quarry, which was awaiting shipment. The new engineer would not accept any stone from this quarry and obliged them to secure other stone at an increased expense. They claimed that all the stone had been accepted by the acceptance of the quarry itself and they were entitled to the difference between the cost of stone from the quarry which the first engineer had approved and the actual cost of obtaining stone from the other quarry approved by the second engineer. The Supreme Court held that the power of the first engineer was limited to inspecting "all material furnished." He could, therefore, accept stone actually furnished to him for use in the structure, but not stone still in the quarry. The second engineer, his successor, could in turn exercise his own judgment in accepting or rejecting stone furnished to him. The powers of each engineer must be construed strictly in accordance with the terms of the contract.

A like stringency in limiting the powers of the engineer to the exact provisions of the contract was enforced by the Court of Claims in a case arising out of the Washington Aqueduct construction. The contract provided that all work done should be "subject to a rigid inspection" and should be satisfactory in every respect to the United States engineer," whose "decision as to quality and quantity shall be final." The engineer made no final inspection but without this certified to the payment and the work was paid for. Afterward it was found that the sub-contractors without the knowledge either of the contractor or the engineer, had fraudulently done their work improperly. The court held that under the contract the certificate must be based upon "inspection" as required by the contract, and that its finality was vitiated by the want of it. This case did not go to the Supreme Court of the United States, and it is a question whether the court did not overlook an important principle which would have justified a contrary decision. It is cited as showing the tendency of the courts to assume jurisdiction to decide all questions upon their merits, unless the terms of the contract plainly require them to recognize the power of the engineer or other officer to make a final decision.

Authority on Matters of Law.—The discretionary power of the engineer under such contract provisions is further limited by the rule that it extends to matters of fact and not to the settlement of rules of law.

An illustration of this was found in the case already referred to involving work at St. Mary's Falls. The usual clause making the decision of the engineer officer as to quality and quantity final was in the contract. There was a large amount of earth excavation and deposit. The government engineer refused to measure the earth deposited until after settlement, and certified the quantity as it then appeared. The contractors claimed that they were entitled to have their deposit measured when put in place. The Court of Claims sustained the contractors and thus construed the contract:

"If the engineer officer proceeded upon a wrong interpretation of the contract or excluded from his calculations a factor of which the contractors were entitled to the benefit, the court will grant relief notwithstanding the provision that the decision of the engineer officer shall be final. The provision in the contract 'that the decision of the engineer officer in charge as to quality and quantity shall be final,' refers only to his measurement in point of fact, and not to the principle of law on which it is made, as it is the

province of the court to determine the law of the contract."

This was based upon a similar claim for depositing earth around the base of the Washington Monument. The same provision was contained in the contract making the engineer officer's decision final as to quantity. The officer certified only to the amount after the shrinkage, while the court held that it would inquire into the customary mode of allowance in such cases and rendered judgment for the sum actually due upon measuring the earth actually placed in the embankment.

The application of this principle to particular cases is not always easy, but these decisions show that the courts will see that proper general rules are applied to the particular facts determined by the engineer.

Scope of Power Limited.—Another principle bearing on this subject seems to be involved in the very recent decision of the Supreme Court on the mail messenger contract in New York. This case gave to the government the right to require "any and all new and additional service," as ordered, without additional compensation. Claiming the right under this authority the government increased the contract service about one-third. The Supreme Court held that it was not within the power of the government to ruin the contractor by new and wholly unanticipated demands which caution and prudence, however great, could not have foreseen, and declared that this enormous new service was "clearly not intended by either of the parties to be rendered." If, under the guise of the discretionary powers granted by the contract, an engineer seeks to impose upon the parties something quite outside the fair intent of the contract read as a whole, this decision of the Supreme Court sustains the contractor in claiming the requirement to be outside the contract. This is another application of a very old, familiar and sensible rule that all provisions of any contract must be read together, so as to produce a consistent whole.

Power Final When Exercised.—When an inspector has once accepted supplies or materials, his action cannot be set aside by his changing his mind and rejecting them, or by a new inspector applying a more rigid standard.

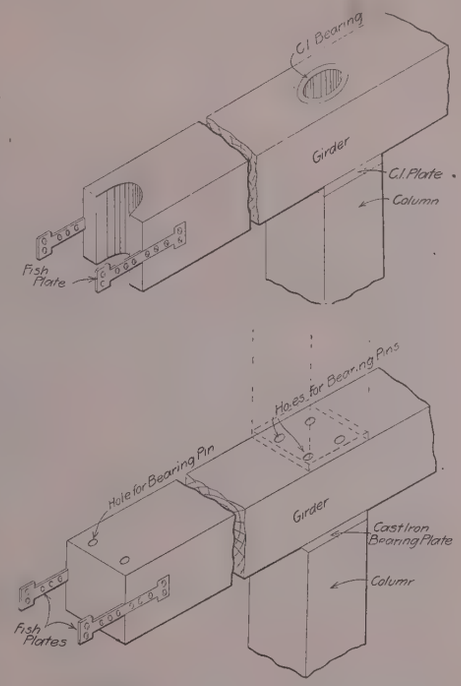
A contract came before the Court of Claims for the delivery of large quantities of flour for the Indian service, with the same provision for inspection as first above quoted in this chapter. Some of this flour was sent out to an Indian Agency, compared with sample, duly inspected, and approved. A later inspection was made by a different officer of the Indian Bureau, who rated the flour as inferior to sample. Payment was withheld. The court held that the inspection once made bound the United States and rendered a judgment in favor of the claimants.

In another case clothing for the Indian service was inspected in New York and passed by the inspector. Another inspector was appointed, who applied a stricter standard and declared it inferior to sample. The government paid for it at a ratable deduction fixed by this inspector under the contract. The Court of Claims held that the government must pay the full contract price, since the discretion of the first inspector was final, when first exercised favorably to the contractor.

In the case of the Puget Sound Dry Dock, the first engineer had already accepted some of the stone delivered at the site. The Supreme Court said that this must be paid for, although, as we have seen, it sustained the later engineer in his refusal to accept further deliveries of the same stone.

Timber was selected by a contractor for fireproofing for the government. Before his buying it and subjecting it to the fire-proofing process, the contractor submitted it to a government inspector, who passed it. It was duly treated, but the next inspector, after its treatment, refused to accept it, not for defects in the fire-proofing, but for defects said to have existed at the time of its first inspection and to have been known to the first inspector. The Court of Claims gave judgment in favor of the contractor for the contract price of the timber.

A case is now on the calendar of the Court of Claims in the writers' own practice, involving a similar point in the construction of locks and dams on the Kanawha River. Stone was cut for face purposes, accepted as such, marked, entered in a book kept for the purpose, banked in the yard for future use, and advances were made on it, as permitted by the contract. The next inspector on duty when the stone was reached for use refused to allow its use for facing stone and permitted it to be used only for a lower classification and at a less price. The contractors are now suing for the difference, claiming that the first acceptance was a finality. The cases already cited seem to require a favorable decision in this case.



Special Framing in Warehouse.

Where the power is given to the engineer to prescribe the order and manner of executing the work, the contractor is bound to submit to the engineer his plans for proceeding. These often involve large expense in procuring machinery. In another case now pending in the Court of Claims, the contractors upon the Warrior River, in Alabama, submitted a plan for dumping concrete, which was approved by the engineer officer. This required expensive machinery, which was bought and installed. About a fifth of the entire work was completed upon this plan, the work approved and paid for, when the engineer suddenly told the contractors that they must adopt an entirely different plan, involving the purchase of new machinery. The question arises here whether the original approval by the engineer of the plan of operations was final or whether he had a right at any time during the progress of the work to declare another method necessary. Certainly justice to the contractor requires that, if the government wishes to substitute a new plan, it must pay the contractor the additional expense involved by reason of the change of mind of its agent. A decision of the Court of Claims is necessary for the settlement of this.

Practical Rules.—As a result of this examination of the decisions of the courts on this subject, some practical rules may be deduced for the guidance of contractors.

1. In bidding upon contracts granting discretionary powers to engineers or other officers, due consideration must be given to the extent of the exercise of such discretion authorized by the contract and the engineer's probable or possible action.

2. Discretion so granted by the contract will in general be sustained by the courts and no relief from injustice given, except within the limitations hereafter stated.

3. If the engineer or other officer is guilty of fraud or of bad faith or of wanton and capricious conduct inconsistent with an honest purpose to carry out the real intention of the parties his decisions will not be binding on the contractor and the courts will give relief from the effects of such misconduct.

4. All discretion granted by the contract to any engineer or other officer will be rigidly confined within its express terms.

5. The power and authority of the engineer does not extend to the determination of general rules of law, but only to the certification of facts and determination of methods.

6. Approval or acceptance by the engineer or inspector when once accomplished is final and cannot be reversed either by himself or his successor.

7. The power of the engineer or other officer will not be extended beyond the fair general scope of the contract.

8. Discrimination between the cases where the discretion of the engineer will not be reviewed, and where the courts will grant relief, has been made by the courts upon such close grounds of difference that contractors are not ordinarily safe in deciding these question without the advice of expert counsel.

(To be Continued.)

Curious Framing in an Old Building.

The construction of the New York anchorage pier for the Manhattan bridge has necessitated the removal of one corner of a seven-story brick building for the Keating pipe fitting warehouse and factory. The floors were designed for very heavy loads and were carried by wooden girders supported on the brick walls and on wooden columns. Some unusual and ingenious details were adopted to make the girders continuous over the column tops, to splice them at panel points, and to transmit the heavy column loads through the girders without crushing the latter by the concentrated transverse pressure.

In the warehouse part of the building the 14x14-in. columns 11 ft. apart on centers carry 12x12-in. and 14x14-in. girders 33 ft. long, spliced on the column centers. Solid cast iron cap plates 2 in. thick are interposed between the tops of the columns and the girders and similar bearing plates, not shown in the sketch, are set opposite to them on top of the girders to receive the lower ends of the columns in the next upper stories. The vertical column load is transmitted from the upper to the lower plate through a 7x12-in. elliptical hollow casting 1½ in. thick which is carefully fitted into the girder so as to distribute the load over a good proportion of the area of the cast iron bearing plates and at the same time leave a considerable portion of the cross section of the girder uncut.

This elliptical thimble was made slightly shorter than the depth of the girder, and was seated, top and bottom, on a thin sheet of lead which allowed it to adjust itself to the exact distance between bearing plates and compensated for small imperfections in the unfinished surfaces of the castings and in the dimensions of the girder. The abutting girder joints were made as indicated at

one end, on the center lines of the thimble holes, and were spliced with pairs of forged side plates with enlarged heads to take bearing on the ends of the fibers. The plates were countersunk flush with the faces of the girders and were secured to them with lag screws.

In another part of the building where the floors were evidently designed for lighter loads the beams and columns were somewhat smaller, and instead of the elliptical cast iron thimble and lead top and bottom plates the column load was carried through the girder from bearing plate to bearing plate by four cast iron vertical cylinders, 2 in. in diameter, with their ends faced to accurate bearing on the cast iron plates. The girders have full square butt joints secured with countersunk side plates as before described. The building has been built many years and no record was found of the architect and builder, but the materials and workmanship are excellent and the structure is strong and well preserved.

Terraced Roadways for Steep Streets.

Some months ago the Merchants' Association of San Francisco retained Mr. Wm. Barclay Parsons to make an examination of traffic conditions in that city. In one section of his report he considers the improvement of some of the very steep streets, which have grades of 15 to 19.4 per cent. Practically there is an abrupt declivity nearly a mile long where the supplies to the houses must be delivered by hand on account of the street grades. California St., 85 ft. wide between houses, is used as an example in Mr. Parsons's report. There are many places in San Francisco where the effective width of sidewalk between area railings and curbs does not exceed 6 ft., a width that is sufficient, unless the number of pedestrians is great, or unless it be a shopping street, where people stand. Neither of these conditions will ever obtain on California St., where the gradients are steep. If the sidewalks were reduced to this width, there will be left for the roadway 73 ft. Instead of running this roadway straight up the hill, it can be carried in a series of inclined terraces having a width of 18 ft., sufficient for two vehicles to pass.

Taking the steepest block, where the elevation to be overcome is 75 ft. in a distance of 412 ft. 6 in., giving a rise of 18.2 ft. per 100 ft., the length of an incline whose direction on the straight parts would be at right angles to the axis of the street would have a length along its center line of 762 ft., to ascend the same elevation, giving a rise of only 9.84 ft. per 100 ft. This is a gradient that horses can climb and descend.

At each bend there could be built a stub-end roadway directly next to the curb and descending at any convenient slope, but preferably at about 5 per cent. A wagon or carriage wishing to reach a house not located on the bend of the roadway could turn into any one of these terraces, and as they form with the curves a series of roadways on each side making an almost continuous stretch, it would be possible to stop a wagon in front of every door. At the same time the sidewalks should be reconstructed to the new grades, and to compensate for the difference between the two gradients short flights of easy stairs should be introduced, most conveniently at or near the ends of the stub roadways. The present sidewalks with over 18 per cent. rise are exceedingly difficult to climb, but walks on a 5 per cent. rise with short flights of about 14 steps every 80 ft. will be found entirely convenient, in Mr. Parsons's opinion.

The space between the terraces on California St., or on a wider street if one should be made, can be partly laid out with parks and made an attractive as well as a practical improvement of the first magnitude. No changing of houses and no acquisition of private property will be needed for this improvement. The cost will be confined to the doing of the work, which will consist of regrading the surface of the street, where excavation should substantially balance fill, the building of the terrace walls, amounting to about $50,000 for the two blocks, and in repaving.

On streets of less width than 85 ft. the same improvement, as heretofore stated, can be worked out, although, of course, on a somewhat smaller scale than was shown for California St. As an illustration, a standard San Francisco street with a width of 68 ft. 9 in. has been taken and a gradient of 22 per cent. assumed, this being in accordance with the facts as now existing in certain streets. Under these conditions it is found that a terraced roadway 16 ft. wide and with a gradient of but 11 per cent. can be built, showing that this same method can be applied at a comparatively small expense to make even narrow streets available for a class of traffic heretofore forbidden. The assumption of a 22 per cent. grade being practically a maximum, it will be understood that the application of the suggested improvement upon less hilly streets will be still more effective. Thus, upon streets having gradients of 16 per cent., of which there are many in San Francisco, the grade may be reduced to approximately only 8 per cent.

Proposed Terraced Roadway on California St., San Francisco.

The Sewer Flush-Tanks of a city have lately been inspected at the request of the water department and an enormous waste was detected in them. Instead of using 12½ gal. per hour and discharging once in twelve hours, as intended, they were averaging 208 gal. per hour. The importance of inspecting such tanks is great, for while they are automatic when in good condition, there is a chance of their derangement from causes not due to the nature of the apparatus. The water is usually admitted through a cock, and the amount of opening of this cock adjusted so as to give the right amount of water. Unfortunately, the cock is easily changed, and then the trouble begins. To remedy it, a number of water departments insist on the use of an orifice in the supply pipe which will not permit an excessive amount of water to enter the tank, no matter how wide the cock may be opened.

Reinforced Concrete Conduits.

Reinforced concrete conduits made in short lengths and then lowered into place and jointed have been used in several places in Michigan. This is the general method of construction suggested by Mr. Quinton in his paper on the bursting strength of reinforced concrete pipes reviewed at some length in The Engineering Record of Dec. 9, although the details of the construction are materially different. The system employed has been developed by the Jackson Cement Sewer Pipe Co. and was recently used on a number of sewers 2 to 4 ft. in diameter in Wyandotte. The pipes are made in short lengths under cover at the site of the work. Each length is reinforced by rings and longitudinal rods, the ends of the latter projecting somewhat to assist in jointing the sections when in the trench. The joint itself is run with cement grout. Although short lengths of cement pipe have been employed for a great many years, this use of reinforcement in them is comparatively new. It will be interesting to observe from the experience with these Michigan sewers, whether the reinforcement overcomes the objections to cement pipe, which were strong enough to lead to its general disuse. It is safe to say that much of the old disfavor was due to the poor quality of the pipe, for some excellent results have been obtained with well made cement sewer pipe. Now that the general quality of concrete work has been greatly improved, there is no reason for any objections to cement pipe on the score of quality.

The Construction of Earth Dams in Great Britain is often marked by very deep trenches for the core. In the West Baldwin dam of the Douglas water works on the Isle of Man, for example, the trench was carried down to an average depth of 50 ft. below the surface although the embankment has a maximum height of only 75 ft. above the river. This trench was filled with clay puddle brought from a place 4 miles distant over a railway built for the purpose. The puddle was carried up 5 ft. above the elevation of the waste-weir, which is segmental in plan and about 70 ft. long. The reservoir holds 360,000,000 gal. and is fed by a drainage area of 1,685 acres. The earth for the main body of the dam was obtained by a steam shovel from the site of the reservoir.

Book Notes.

Everybody who has any connection with railway structures will be glad to know that the American Railway Engineering and Maintenance of Way Association has issued a volume of its approved definitions, specifications and principles of design, thus collecting within a single cover the invaluable data hitherto obtainable only by a tedious hunt through a number of volumes of proceedings. The title of the book is "Manual of Recommended Practice for Railway Engineering and Maintenance of Way," and it is published under a rule adopted at the Association's fifth annual meeting. The contents are classified in fifteen sections relating to roadway, ballasting, ties, rails, track, buildings, masonry, signs, fences, crossings and cattleguards, signaling and interlocking, records and accounts, water service, yards and terminals, iron and steel structures. The editorial work shown in the arrangement of the text is excellent. Each section is preceded by the definitions of the special terms of the subject of the section, marginal notes enable the nature of each paragraph to be quickly understood, and an index to each section makes it possible to look up any part of it quickly. Illustrations are used wherever desirable, and the result is the most convenient technical reference book yet produced in this country. The nature of the contents has been referred to so often in these pages that it is unnecessary to say more in this place than that the book should be in the hands of everyone who desires to know what the leading railway engineers of this country consider the best standard practice. Every word in the book has been subject to careful scrutiny and many of them to earnest debate, and the book is truly a "standard." It contains 170 pages and is sold at $3 at the Association's office in the Monadnock Block, Chicago.

The seventeenth annual report of the Interstate Commerce Commission on "Statistics of Railways" covers the year ending June 30, 1904, and is a book of 709 pages. The reports made to the Commission show that on the date named there were 1,296,121 people employed by the railways of this country. On the basis for five persons to the family, this is equivalent to nearly 6,500,000 people who are dependent on the railways for their living, a proportion of the total population which must be looking with much anxiety to the suggested action of Congress placing the railways under what is equivalent to government ownership without government responsibility for its consequences. These men were engaged in operating 212,243 miles of road, or about 297,000 miles if second tracks, sidings and other lines are counted. Consequently there were 611 employes per mile of track, 120 of whom were employed on trains. The average daily pay of the general officers was $11.61; other officers, $6.07; general office clerks, $2.22; station agents, $1.93; enginemen, $4.10; conductors, $3.50; dispatchers, $2.15. The capital stock of these railways was $6,339,899,329, or $30,836 per mile. The funded debt was $6,873,225,350, or $33,429 per mile. The total capital stock and funded debt was $64,265 per mile. Of this amount the railway companies themselves owned 20.69 per cent. Dividends were paid on 57.47 per cent. of the stock, at an average rate of 6.09 per cent. If the total sum paid out in dividends was distributed over all the outstanding stock, the average rate would be about 3½ per cent. The largest single item of freight carried by the railroads was bituminous coal, of which 303,700,000 tons were transported; 117,300,000 tons of lumber, 91,400,000 tons of anthracite coal and 87,500,000 tons of grain, flour and other mill products followed in the order mentioned. The total amount of freight shipped was 1,309,900 tons, and the total number of passengers carried was 715,400,000. To handle this traffic there were 46,743 locomotives and 1,798,561 cars, exclusive of equipment not owned by railway companies.

The "Proceedings" of the twenty-fifth annual convention of the American Water-Works Association form a book of 444 pages containing much valuable information to the manager and designer of water-works. Inasmuch as the convention was reported quite fully in this journal last May it is not necessary to explain the contents of the book at any length. It contains one interesting paper which was not read at the meetings, a description of the Tokyo water-works by the chief engineer of the city, Mr. Y. Makajima. The first supply was brought to Tokyo about 300 years ago by open canals, covered stone conduits and wooden pipes. The new works were started in 1892 and water was turned on in 1898. The works are designed to supply a population of 1,500,000 with 4 cu. ft. per day, but it will be possible to extend their capacity one-third by constructing small additional works. The water is taken from a river 30 miles from the city and is usually clear and of excellent quality. It is subject to periods of turbidity, however, and accordingly three settling basins of a capacity of 9,000,000 cu. ft. have been built, and when natural subsidence is not sufficient to clarify the water in them alum is added. From the basins the water passes to 18 filter beds with a total area of 780,000 sq. ft. The beds have 30 in. of sand resting on 24 in. of gravel. There are three clear-water service reservoirs, each of 2,000,000 cu. ft. capacity. About a third of the population live in a high-service district to which the water must be pumped; the remainder live in districts supplied by gravity. The cast-iron street mains were imported from Belgium and Great Britain, but some of the smaller pipes and most of the specials were cast in Japan, as were the small valves and fire hydrants. Over 20,000 meters have been imported from several countries. All of the plumbing is done by city employes at the expense of the consumer, the lead pipe and brass fittings being made in Japan. The works cost $4,130,000 and were paid for in 6 per cent. 30-year bonds. The charges are $2.50 a year for one faucet for a family of five people and 25 cents a year for each additional person; each extra faucet is $1.50. For a poor family taking water from a street fountain there is a charge of 75 cents a year.

The British Fire Prevention Committee has issued two more valuable "red books." The first describes a fire test of a Kinnear rolling shutter which was hung in a 9 x 8-ft. doorway in one of the new testing huts, fired with producer gas, recently built by the Committee for such investigations. The shutter was made of No. 20 galvanized steel strips, welted together in the usual manner with this type of door. The gas was lighted at noon and after an hour, when the temperature had risen to about 1,600°, the top was at a bright red heat. Twelve minutes later the whole shutter was red hot and at 1:30, when the gas was shut off the temperature was about 1,800° and flames were issuing over the top of the shutter. At no time did flame pass through the shutter or around the sides, but only over the top. The second report gives the results of a fire test of a floor constructed according to the Bremer system, which may be termed a reinforced terra cotta system. The test was made in a hut 10 ft. wide, 22¼ ft. long, and 8¼ ft. from the pavement of the bottom to the under side of the floor to be tested. The latter was made on a center and consisted of hollow porous terra cotta blocks 9¾ in. long and 6 in. square, with walls 1½ in. thick. They were laid with their long dimension transverse to the chamber, the blocks in each row butting, but the different rows separated about 1¾ in. Half-inch rods were run in each open joint and others crossed them in a recess left for the purpose in the end of each block; this reticulation was about 1½ in. above the finished bottom surface of the floor. The blocks were carried 4½ in. over each wall, and ½-in. reinforcing rods were also placed around the sides of the floor on top of the blocks. The blocks were laid in 1:3 Portland cement mortar, covered on the top with ¾ in. of cement rendering and on the bottom with half an inch of lime plaster. The gas was lighted at 4 p. m., and in a very few minutes the plastering began to fall. In an hour, when the temperature was about 1,400°, hair cracks appeared in the joints between the blocks. At 6:15, when the temperature was about 1,700°, a longitudinal crack appeared along the center of the floor for about two-thirds of its length. The gas was turned off at 6:30 and water under a pressure of 65 lb. was applied for two minutes from a ¾-in. nozzle, which washed off all the remaining plaster and removed some of the cement in the joints, so as to expose the rods in places. Neither fire nor water passed through the floor. The floor was loaded before the test with brick so as to produce a distributed load of 224 lb. per square foot, and the maximum deflection during the test was 3 in. These reports are sold at 2s. 6d. each at the offices of the Committee, 1 Waterloo Place, Pall Mall, London, England.

HYDROGRAPHIC SURVEYING. Methods, Tables and Forms of Notes. By Samuel Hill Lea. New York, Engineering News Pub. Co.; cloth, 8vo, 172 pp, $2.00.

Hydrographic surveying is not a particularly difficult branch of the art, yet it calls for considerable patience and skill and can be materially assisted by a resort to various methods that are not self-evident to the surveyor who takes up such work for the first time. In this little work by Mr. Lea there will be found many useful suggestions concerning methods of shortening the time required for different kinds of observations and hints regarding ways to improve the accuracy of work. It is the kind of a book that will appeal to the young engineer who secures an engagement or a party employed on such work and wishes to read up the subject before starting out.

The author discusses the subject under two different heads, surveying and the measurement of stream flow. Under surveying he describes the methods followed in making surveys of water courses and reservoir sites, soundings, working up notes in the office and measuring dredged material. Under stream gauging he explains the methods of using floats, current meters, weirs and the like. In all cases the subject is discussed from the point of view of the government engineer, and a large proportion of the examples of actual practice described are taken from government sources. This is naturally the case because a very large part of all such work in this country is done by the surveyors of the various federal departments.

THE NEW COVERED RESERVOIR at Chelmsford, near London, has a roof differing materially from those generally built in the United States at present. The basin is 200 ft. square, with a concrete bottom 18 to 21 in. thick and concrete walls averaging 12 ft. high. There are 95 brick piers 18 in. square, which support steel beams, the roof being of concrete reinforced with expanded metal, and covered with 12 in. of soil.

Letters to the Editor.

Roads Across Marshes and Bogs.

Sir: With reference to the letter of Mr. Patrick Saunders in your issue of Dec. 16, I wish to give the result of considerable experience in the construction of wagon roads and railroads over bogs and marshes in Scotland. The method generally adopted there is to distribute the weight by means of a good layer of brush, which forms a mattress, and also to drain effectually the surface. At the same time the drainage ditches should be so disposed as not to impair the sustaining power of the natural crust of the bog. The accompanying sketch gives a typical plan and cross-section of one of these wagon roads. On top of the bog is a layer of brush, over which is a "blinding" of material taken from the ditches, which, it will be seen from the plan, do not come within about 25 ft. of the roadway. On top of this blinding is a 9-in. layer of large stone and on top of that 5 in. of gravel or small broken stone. A road like this will sustain great weights, especially after the drainage has taken effect.

Yours truly, Grieve Macrone.
Savanne, North Ont., Dec. 20.

Sir: The letter of Mr. Saunders in your issue of Dec. 16 reminds me of a road that I once saw built to facilitate bringing machinery and building materials to the site of a large mill in course of construction. This mill was located on the shore of an inlet and was separated from the railroad over which the material was delivered by a steep hill. It was intended to build a pile trestle from the railroad around the base of this hill over a marsh to the mill site. For some reason there was every prospect of an interminable delay in the delivery of the piles, and the boss of the erecting gang of the steel contractor, who happened to visit the place to arrange for his part of the construction, offered to build a road that would be good enough for teaming and probably for a spur track. As we were being delayed seriously by the difficulties of getting materials over the hill from the railroad, this man was told to go ahead.

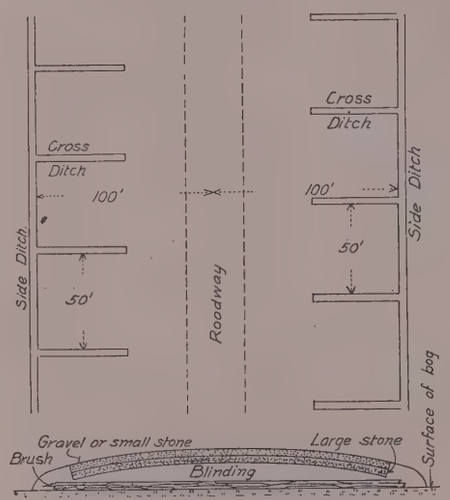
He first secured all the driftwood in the vicinity and placed it along the line of the proposed road, which was a marsh of soft mud covered with high grass. If I recall rightly, the bottom layer of sticks ran lengthwise and was covered by a top layer placed crosswise. While this was being done a number of men cut down the high marsh grass wherever the surface was strong enough for them to go, and this was spread over the timber. There was a considerable quantity of this grass, and when it was covered with the earth from the excavations for the footings of the buildings it made a very satisfactory road. After it was used for a time without settlement that could not be filled in without trouble, more earth was put on it and the spur track laid over it. All the machinery and a large part of the building materials were delivered over this road, which was at least a quarter of a mile long where it crossed the marsh. Soon after the mill started up the road was injured by a high flood, and a pile trestle was constructed as originally proposed. It seems to me that the strength of the road was due to the fact that the surface of the marsh was not cut at any place by the men, who simply laid materials on it which distributed the weight over a large area.

Yours truly, James W. Knight.
Pittsburg, Dec. 18.

British Sewage Disposal Works.

Sir: Last spring, in a moment of mental aberration, I consented to serve on the board of public works of the city where my business is located. There was a reform administration elected at the time, and my particular part of the performance was to reorganize the department of public works, an education as a mechanical engineer and a measure of success as a manufacturer being considered by my fellow citizens satisfactory proof of fitness for the task. The serious problem with us at present, outside of persuading good men to enter the public service, is that of sewage disposal. After reading the long list of books you were good enough to send me and becoming completely muddled by the conflicting statements in them, I decided to visit England and see what was really being done there. After spending three months in visiting works, talking with their managers and studying the results of operation as well as a limited knowledge of chemistry has permitted, I have to confess that there is just as much uncertainty in mind concerning the proper course for us to pursue as before coming over here. Inasmuch as several of my acquaintances have expressed some interest in my experience I think that your readers may care to know something about it.

Our sewage disposal problem is complicated by the fact that the waste liquors from a large tannery and a number of dye-works are discharged into the sewers, together with the liquors



Scotch Bog Highways.

from a number of industrial establishments where considerable quantities of water are used. There is also some talk of a starch factory being located in the city. If we were to compel these works to purify their sewage before it was discharged into the sewers several of them would unquestionably move to other places, as our railway facilities are not of the best and some of the manufacturing companies are already seriously considering removal on that account. Consequently, it will be necessary for us to purify a sewage which is decidedly industrial in character, and on this account the problem is more serious than in any American city where sewage is now being purified. We have had in the past several reports made on the subject by engineers of the vicinity and there have been several voluntary reports by parties with patented methods of apparatus to sell, but nothing really serious has been done. It was to find out definitely what was the proper procedure for us to take that I have been spending so much time over here.

There are many statements in reports and technical journals concerning the satisfactory operation of disposal plants in English cities where the sewage contains quantities of industrial wastes. It is possible that some of these assertions are strictly correct, but as a rule I have found that the effluents are subject to periods of continued poor quality and in many cases the degree of purification that is desired and attained would not be satisfactory to us. In some cases it is hard to say just what is being accomplished because of the character of the chemical analyses that are made; a chemical expert might secure some useful data from them but I have been unable to do so. I have learned one important fact, however, and that is the possibility of securing equally good results by different processes with sewages of practically the same character. This observation does not apply to strong industrial sewage, like that of our town, but to the ordinary city sewage which is not seriously altered by powerful chemicals. Such sewage can unquestionably be satisfactorily purified by a number of means, and I am convinced that the engineering problem with them is one of selecting the method best adapted to the local conditions of the case in hand. It is evident that contact beds are not holding the favor in England with which they were formerly regarded, but perhaps an explanation of this is to be found in the unsuitable material often used in them in England. I have repeatedly seen filters and contact beds made of material which was altogether too soft and friable for the purpose.

When it comes to the treatment of industrial sewage I find the most conservative managers hold that only a thorough investigation of the character of the sewage and the effect of different methods of treatment and combinations of methods will furnish the information on which an opinion can be based. The men whose work seems best to me freely confess to a complete lack of knowledge of any simpler way to ascertain how to treat an industrial sewage. I find that there have been many failures to secure good results with raw sewage of this nature in England, although the methods adopted had proved satisfactory elsewhere. Consequently, I am thoroughly convinced that the most economical method for us to follow at home is to employ some experienced specialist and have him conduct a thorough examination of our sewage and methods of treating it. It will involve a considerable expense, but I am certain, from what I have learned over here in the home of sewage disposal, that the large initial expense will be saved by the successful operation of the works which this specialist will be able to design for us. This visit to England has shown conclusively that the purification of industrial sewage is one of the most difficult engineering problems which a city must solve.

Yours truly, Observer.
London, Dec. 14.

A Submerged Pipe for the Passaic Water Co., Mr. R. N. Cuddahy, chief engineer, has recently been laid in record time by the T. A. Gillespie Co. The pipe is 43 in. in diameter and is made with the lock bar joint manufactured at the contractors' shops, Paterson, N. J. The river at this point is about 330 ft. wide with a maximum depth of about 3 ft. and a moderate current. A double row of 2-in. hemlock sheet piles with square edges was driven on each side of the center line of the pipe, penetrating to firm soil under a bed of quicksand 2 to 3 ft. thick, which was unexpectedly encountered. An excavation 7 ft. deep was made between the sheet piles from one shore to the middle of the river and the water was kept out by two 6-in. plunger pumps. The pipe was riveted up in position and back filled and the same operations were conducted on the other half of the crossing. During the pipe laying there was a 3-ft. freshet but the work was successfully accomplished in about six weeks and within the contract price. It was considered that the results were somewhat exceptional for work done in quicksand and subject to freshets where only hemlock sheeting without covered joints was used.

CURRENT NEWS SUPPLEMENT

DECEMBER 30, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Charles Warren Hunt, 220 West 57th St., New York. Next meeting, Jan. 3. Paper on The Position of the Constructing Engineer; His Duties in Relation to Inspection and Enforcement of Contracts.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, F. R. Hutton, 12 West 31st St., New York.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty St., New York Next meeting, Jan. 26, 44 West 27th St., New York.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary, W. H. Merrill, Jr., Chicago.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, R. W. Raymond, 99 John St., New York.

AMERICAN INSTITUTE OF ARCHITECTS. Secretary, Glenn Brown, Washington, D. C.

ASSOCIATION OF ENGINEERING SOCIETIES. Secretary, Frederick Brooks, 31 Milk Street, Boston, Mass.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Secretary, W. M. Mackay, 235 Water St., New York. Annual meeting, Jan. 16, 17 and 18, 12 West 31st St., New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

AMERICAN PUBLIC HEALTH ASSOCIATION. Secretary, Dr. C. O. Probst, Columbus, O.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS. Secretary, S. F. Paterson, Concord, N. H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

AMERICAN WATER-WORKS ASSOCIATION. Secretary, J. M. Diven, Charleston, S. C.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Richard Moldenke, P. O. Box 432, New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

AMERICAN PUBLIC WORKS ASSOCIATION. Secretary, W. H. Flint, Chattanooga.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. Secretary, H. W. Ross, Room 806, 258 Broadway, New York.

NATIONAL ASSOCIATION OF MANUFACTURERS OF SAND-LIME PRODUCTS. Secretary, H. A. Duerr, Wilmington, Del.

NATIONAL ASSOCIATION OF CEMENT USERS. President, Richard L. Humphrey, Harrison Building, Philadelphia, Pa. Annual meeting, Milwaukee, Jan. 9-12.

SOME REMARKS ON ADVERTISING

At a recent meeting of the Technical Publicity Association Mr. George H. Gibson, of New York, read an interesting paper on lost motion in machinery advertising. As a considerable number of the readers of this journal are connected with companies which advertise their products extensively, the portion of Mr. Gibson's paper concerning the relation between circulations of publications, rate cutting and commissions is here reproduced as a fair statement of a business matter of considerable importance.

The connection between circulations and unstable rates is this: If a paper is charging rates equal to those charged by a paper of five times the circulation, it means that the first paper can afford to sell its space at any price from the full card-rate down, say to one-third, and that it can afford to pay big commissions. This is not a condition favorable to economy in the purchase of advertising space and circulation. When the advertiser spends $1,000 for advertising space, he ought to get $1,000 worth of paper and press work, postage and editorial service and business management. I do not see why he should pay for $500 worth of misrepresentation or $375 worth of hypnotic ability. I am led to say this by the fact that I have known some papers to cut their rates in two or more, and I have known others to offer commissions as high as 37½ per cent. An instance has recently been related to me in which a publisher offered a solicitor 50 per cent. commission in addition to a salary of $30 per week. High commissions in the advertising business, as in the insurance business, are an indication of unhealthy conditions.

As you may know, the concern which I represent does not work on the commission basis; nevertheless we daily receive offers of commissions from some papers, and have in various ways learned of the commissions paid to agents by other papers. Now this extra margin of profit, or whatever it is that the publisher is able to spare above the cost of conducting and producing his paper, ought, in the interests of sound business policy, to remain in the hands of the advertiser. It is certainly not to the advertiser's interests that it should go to the man who advises him in regard to the selection of his mediums. No matter how honest or impartial a man may be, if he is undergoing the trials and tribulations of an advertising agent, he is doing it, not for philanthropy, but for the commission. He cannot help but realize that if his client should use only the papers which give no commissions, he would be forced out of business, and, on the other hand, if he could bring himself to believe that the papers paying 37½ per cent. were the best ones for his client to use, times would be very good.

On the other hand, if a reduction in rates is made for one advertiser it should be made for all. The privilege of mailing a paper at second-class rates is, in a way, a public franchise, the more so as it is a cause of a large and annual deficit in the Post Office Department, and it should, with the opportunities it offers to the publisher, carry also certain obligations upon his part to the advertising public. Preferential rates are held to be unjust in the railway world; are they not also wrong in the realm of advertising?

Now, the way in which your Association can bring about better conditions in this matter is by insisting uniformly, persistently and strenuously that, where a paper is known to give commissions or cut-rates to anybody, it should give the same reductions to the advertiser who employs his own salaried advertising expert. I have many times seen publishers, when pressed for the reason which led them to grant an agent's commission contrary to their own expressed wishes and ideas of square dealing, shrug their shoulders and say, "We wanted the business and we couldn't get it any other way." Well, if that's the way it works, I see no reason why the advertiser, himself, if he tries, should not get a discount from such papers directly. He is certainly as worthy of the trade paper publisher's consideration as is the man whom the publisher habitually refers to as a nuisance or something worse, or as is another advertiser who has had the patience to stand out longer for the cut in rates which he knew was there.

I am happy to be able to state that the publisher of four of the leading engineering journals has recently issued a notice cutting off all commissions and that the list of non-commission-paying and non-rate-cutting journals now includes most of those of high standing. However, much still remains to be done. I do not advise that action be taken suddenly or without due notice, or by a few without the support of the remainder, but if you will appoint a committee to take this subject under consideration, to collect information and to confer with the publishers, you can undoubtedly to much toward bringing about a stable state of affairs which I am sure all advertisers, all legitimate publishers and all honest advertising men heartily desire.

THE IRON AND STEEL INDUSTRY.

The report that the United States Steel Corporation has on its books orders aggregating over 7,300,000 tons is true, according to the "Iron Age." No one fact could better serve to show the condition of the steel works and rolling mills of the country, since it is well known that the other large companies are similarly committed for their full capacity for a long period to come. There have been rumors of cancellations during the past few days, which on investigation resolve themselves into the solitary probability that the material for the railroad enterprises of John R. Walsh, of Chicago, whose failure was announced this week, will not be required. It is estimated that this involves a fair quantity of rails and some rolling stock. It will leave rather a welcome gap in the rolling programme of the mills affected.

It is semi-officially announced, according to the "Iron Age," that the policy of the United States Steel Corporation in handling its pig iron purchases will be guided by a determination to prevent an undue rise in prices. Whatever metal is available will be taken, but if there is a shortage to cover requirements, the latter will be scaled down. The Steel Corporation is making about 900,000 tons per month and needs from 30,000 tons to 40,000 tons of outside iron per month, running at the present rate. The new Mingo furnace in the Wheeling district will start in January and the slowing down of the mills for repairs and for the holidays will allow some accumulation. In the interests of a stable market it is believed to be wiser to slightly curtail operations at the steel works rather than take the risk of forcing the market up by buying relatively insignificant quantities of outside iron.

A shortage of basic pig has again developed in the Eastern markets. One steel works took 5,000 tons at $17.90, delivered; another took a like quantity, while a third purchased 15,000 tons in addition to purchases of 10,000 tons made a short time ago. A fourth Eastern steel company is now in the market for 18,000 to 20,000 tons for delivery during the second half of 1906.

The scarcity of steel is indicated by the fact that the Ohio works of the Carnegie Steel Co. will be taken off from rails and put on sheet and tin plate bars in January. Only about 75 per cent. of the sheet mill capacity of the corporation can now be operated on account of the scarcity of steel, while 92 per cent. of the tin mills are running, when more capacity ought to be employed. It was hoped that the wire trade would slacken this month so that steel could be diverted, but the pressure on the wire mills is too great.

The structural trade is working under tremendous pressure, the open winter facilitating outdoor operations. The product of the new Chicago and Clairton mills of the Steel Corporation has been absorbed without relieving the situation. Next month the new mill of the Jones & Laughlin Steel Co. will be in operation. It will roll intermediate sizes and have a capacity of 800 tons a month.

A heavy tonnage is coming up for bridges for the railroads. There are now in the market inquiries from three systems alone which need 72,000 tons among them. The demand for steel for buildings is very heavy. Chicago notes one lot of 11,000 tons for a county building. In Pittsburg bids are going in for two structures requiring 12,000 tons and New York has a number of large structures which may soon be ready for contracting, unless the labor situation should become too serious.

There is a heavy export movement in progress, and a very much larger tonnage could be taken were it not for the pressure of requirements from the home markets. Among recent inquiries is an aggregate of 20,000 tons of rails for New South Wales and Mexico. The large Canadian business has not yet been placed.

The cast iron pipe industry continues to flourish. It is stated that never before so far in advance of the season had so much business for spring delivery been booked. Philadelphia gas interests have just placed heavy contracts, but as they were distributed among several foundries the total tonnage is not known. The Philadelphia Water Department will shortly call for bids on a large quantity of 48-in. pipe and it is expected that the New York Department of Water Supply will ask bids on a large lot of the same size.

THE CERTIFICATE OF AN ENGINEER FOR WORK DONE.

The Supreme Court of Minnesota has recently rendered a decision in Robertson vs. Village of Grand Rapids that is of much interest as showing the binding character of an engineer's certificate for work done, as well as the necessity of having penalty clauses in a contract drawn up in clear language. The decision as given in 104 N. W., Rep. 715, reads as follows:

June 14, 1902, appellant (the village) advertised for bids for an electric light plant, calling for sealed proposals, according to specifications and plans to be furnished by appellant. The instructions accompanying the plans and specifications stated that all proposals must be carefully and completely made on the printed forms annexed, and would be received for the following work: Building, machinery and electric lines, and for one or more of such parts, preference to be given those for the entire work. The specifications provided that Edward P. Burch, of Minneapolis, was the consulting engineer, and that, should any discrepancy appear or any misunderstanding arise as to the import of anything contained in the plans and specifications, the decision of the engineer should be final and binding upon the contractor; that the engineer might make any reasonable alterations in the line, grade, form, position, dimensions or material of the work, either before or after its commencement, provided such reasonable alterations did not materially increase or diminish the quantity of the work to be done. It was further provided that, in order to prevent disputes and litigation, the engineer should be referee in all cases to determine the amount or quantity, all questions with reference to the completion of the work, and that his decision should be final and conclusive. It was further provided that, when the work was completed to the satisfaction of the engineer, he should report the same to the council, whereupon the village within 30 days thereafter should pay to the contractor the whole amount of money accruing to him, except such portions thereof as might be lawfully retained by it.

With the exception of certain general provisions, applicable to all, the specifications were divided into three separate parts, in accordance with the original advertisement and instructions, viz., building, machinery and electric lines, and each part was treated independently, and so drawn that there might be three independent bids and contractors. The time fixed for the completion of the building was Oct. 31; for the electric lines, Nov. 30; and for the machinery, Dec. 31, 1902. Upon one of the blank forms furnished by the village respondent (Robertson) formulated his proposal, bearing date July 8, 1902. The printed form was so drawn as to permit of the submission of a bid for either the building, machinery or electric lines, or for the entire construction; four separate headings being provided for that purpose. In the proposal submitted by respondent the form was changed so that the proposal read: "For machinery and electric lines, $24,500." The printed form also contained an agreement to enter into a contract within 30 days after receipt of notice of the acceptance of the bid and an agreement with reference to stipulated damages, which will be referred to later.

The proposal having been accepted, the parties entered into a formal contract, dated July 8, 1902, in which it was agreed by respondent that in consideration of the sum of $24,500 he would furnish and deliver, according to plans and specifications, all the material, machinery and labor mentioned and described in his proposal thereto attached and made a part of the contract, and to erect, construct, establish and turn over after full test thereof, a complete electric lighting plant, as aforesaid, within the time in said plans and specifications mentioned; and among other things it was stated that it was the intention of the parties to accept, ratify, perform and be bound by all the provisions of the said plans, specifications, advertisement, instructions, proposal and all documents relating thereto and attached.

The building was erected by another party, under separate contract, and respondent proceeded to furnish the machinery and electric lines. The work progressed during the fall and winter of 1902. Payments were made, from time to time, upon the certification of the consulting engineer, based upon the percentage of work done and material furnished, and on March 2, 1903, the engineer directed a communication in writing to the village council, in which he declared that the specifications for the machinery and electric lines were more than fulfilled by respondent, that the work and material furnished had been more than required by the specifications, that the tests of the machinery had been according to contract, and that the work had been completed to his satisfaction, and directing the village to pay the contractor within 30 days the whole amount of money due, except such portions as might lawfully be retained, and also certifying that at the time the sum of $800 was due on the contract.

This action was brought to recover the sum of $2,400, conceded to be the balance of the contract price still unpaid. The defense consists of a denial that the contract was completed. A counterclaim was interposed upon the theory that the village was entitled to the amount of stipulated damages referred to in the proposal for at least the time elapsing from Dec. 31, 1902, until March 2, 1903, and other counterclaims for damages growing out of the failure of respondent to furnish proper material and workmanship. At the close of the case the trial court directed a verdict for respondent for the entire amount, thus withdrawing from the jury consideration of all of the counterclaims.

1. In the absence of any evidence to indicate that the engineer was acting in bad faith or according to demonstrable mistake of facts, his certificate to the effect that the contract had been completed according to the plans and specifications was final. The work was required to be done to the entire satisfaction of the engineer, who was given authority to make reasonable alterations, and the stipulations to the effect that he should be the referee in all cases, in order to prevent disputes and litigation, did not limit his authority to the settlement of actual disputes. There is no evidence to indicate that any objections were made to the materials, the work, or the conduct of the engineer until after the contract had been substantially completed and a new village council had been elected.

This disposes of all such counterclaims, and, although the evidence with respect to these items is very long, we fail to discover that there was any fraudulent intent to evade the terms of the contract, or that the engineer was demonstrably acting under a misapprehension as to the facts. With reference to the filter, upon which so much stress was laid at the argument, it is very clear that neither within the letter nor spirit of the specifications and contract was respondent required to furnish such an article. The provision was that the contractor was to provide piping for the condenser, as specified, the discharge from the condenser to run to a suitable point outside of the building 35 ft. from the same to a filter. In the absence of specifications as to the character of the filter, it must be taken for granted that appellant expected to furnish it, if such connection should be insisted upon. As to the effect of the engineer's certificate, see St. P. & N. P. Ry. Co. v. Bradbury, 42 Minn. 222, 44 N. W. 1; King v. City of Duluth, 78 Minn. 155, 80 N. W. 874.

2. "It is further agreed that if I shall fail to deliver all materials, or to perform any or all of the services contracted for in accordance with the conditions and requirements of the contract, the village council shall make deductions as follows from the contract price for all materials not delivered or services not rendered by the last day of the time fixed for the completion of the work: For the building at the rate of two-tenths of 1 per cent. of the contract price for each day's delay until the same shall have been completed and accepted. For the machinery, at the rate of one-tenth of 1 per cent. of the contract price for each day's delay until the same shall have been completed and accepted. For the electric lines, at the rate of one-tenth of 1 per cent. of the contract price for each day's delay until the same shall have been completed and accepted. In case the deduction to be made hereunder should equal 6 per cent. of the amount of the contract, the contract may at the option of the village council be canceled; provided, that delays by an injunction, or by strikes, riot, fire or other disaster, may in the discretion of the council be accepted in writing as sufficient for waiving such deductions or cancellation. The said deductions are agreed upon as the liquidated damages that the village of Grand Rapids, Minnesota, will suffer by reason of such default, and not by way of penalty."

We are asked by appellant to hold that because respondent, in the subsidiary contract, agreed to turn over a completed electric light plant on Dec. 31, 1902, it amounted to a waiver of the time fixed for completing the electric lines by Nov. 30, and the stipulated damages for one-tenth of 1 per cent. upon the entire cost, $24,500 for each day's delay, took effect Dec. 31. On the other hand, it is submitted by respondent that when the several documents—advertisement, instructions, specifications, proposal and subsidiary agreement—are considered together, such conclusion is not warranted. It is evident that the stipulated damage provision was put in the printed form of the proposal, in order that it might be made to apply, by slight changes, to separate and independent contracts for the building, machinery, and electric lines. The specifications having provided that the building should be completed Oct. 31, the electric lines Nov. 30, and the machinery Dec. 31, 1902, the rate of two-tenths of 1 per cent. deduction for each day's delay in constructing the building, and one-tenth of 1 per cent. deduction for each day of delay in completing the electric lines and machinery, each, was inserted upon the theory that a definite contract price would be fixed for each of such divisions of work. Had the bidder stated the amount of the cost of the machinery and the electric lines separately, there would be a basis upon which to estimate the rate of one-tenth of 1 per cent. for each day's delay in completion, in each case. But respondent chose to submit a proposition to construct the machinery and electric lines for the total sum of $24,500, and made no change in the provisions concerning stipulated damages to make it applicable. Appellant accepted the bid, entered into a contract, and did not require any change to be made in the agreement as to damages. The problem before the court, therefore, is to determine what was the intention of the parties, and this is to be gathered from the various writings and the printed blanks which, taken together, form the contract.

If the total amount of the bid had been inserted and made applicable to the stipulation for damages, we will concede that the stipulation could be enforced. The actual damages resulting from the delay were not easy of determination, and it was a proper case for the application of such an agreement. And, again, the amount of one-tenth of 1 per cent. of the entire bid, $24, for each day of delay, was not excessive, and therefore, if the language employed by the parties warrants the conclusion that they intended the stipulation to apply, there appears to be no reason why it should not be enforced as stipulated damages, within the principles illustrated by several decisions of this court. Carter v. Strom, 41 Minn. 522, 43 N. W. 394; Taylor v. Times Newspaper Co., 83 Minn. 523, 86 N. W. 760, 85 Am. St. Rep. 473; Womack v. Coleman, 89 Minn. 17, 93 N. W. 663.

It has frequently been held that, where the amount stipulated in this class of agreements is to be paid absolutely upon the failure to perform a certain act, the sum stipulated will be construed to be in the nature of a penalty rather than stipulated damages; for instance, Willson v. Mayor, 83 Md. 203, 34 Atl. 774, 55 Am. St. Rep. 339; 5 Am. & Eng. Ency. Law (2d Ed.) 27. If the provision for stipulated damages is indefinite or doubtful, it should not be enforced. Courts are not inclined to enforce penalties and forfeitures, unless such intention clearly appears from the contract. In failing to specifically provide that the one-tenth of 1 per cent. for each day of delay should take effect from the date of completing the entire plant, Dec. 31, it may be inferred that it was the intention of the parties to eliminate from the contract entirely all application of the provision for stipulated damages. We are inclined to the view that the minds of the parties did not meet; the intention not being expressed to apply the payment of one-tenth of 1 per cent. of the entire amount of the contract price for each day of delay after Dec. 31.

The agreement as to stipulated damages is rendered uncertain and indefinite for another reason. "It is further agreed that if I shall fail to deliver all materials or to perform any or all of the services contracted for, in accordance with the conditions and requirements of the contract, the village council shall make deductions as follows from the contract price *for all materials not delivered or services not rendered by the last day of the time fixed for the completion of the work.*" If the words italicized had been omitted, it would be clear that the stipulated amount was to be deducted from the contract price for each day of delay; but such deduction is for all materials not delivered or services not rendered by the last day, etc. If this means that the deduction of one-tenth of 1 per cent. is to be based upon the value of the materials and work not delivered and rendered by the last day of the time fixed for completion, then the amount is uncertain and indefinite, and there is no proper basis upon which the percentage may be computed. If by that language it was the intention to provide that the deduction of one-tenth of 1 per cent. was to be made in lieu of all materials not delivered or services not rendered, then a question would arise whether or not, under the other terms of the contract, the contractor could be compelled to complete his contract if he chose to pay the penalty rather than furnish the materials and labor so delayed. The clause is so uncertain as to make it doubtful in what way the percentage is to be computed. For all these reasons the court was justified in holding that the provision referred to did not constitute an agreement to pay stipulated damages.

Order affirmed.

MUNICIPAL HOUSING IN EDINBURGH.

U. S. Consul Fleming, of Edinburgh, furnishes an interesting report on the operations of the authorities of that city in removing undesirable dwelling houses and the construction of tenements to be let at reasonable rates to working people. The consul writes:

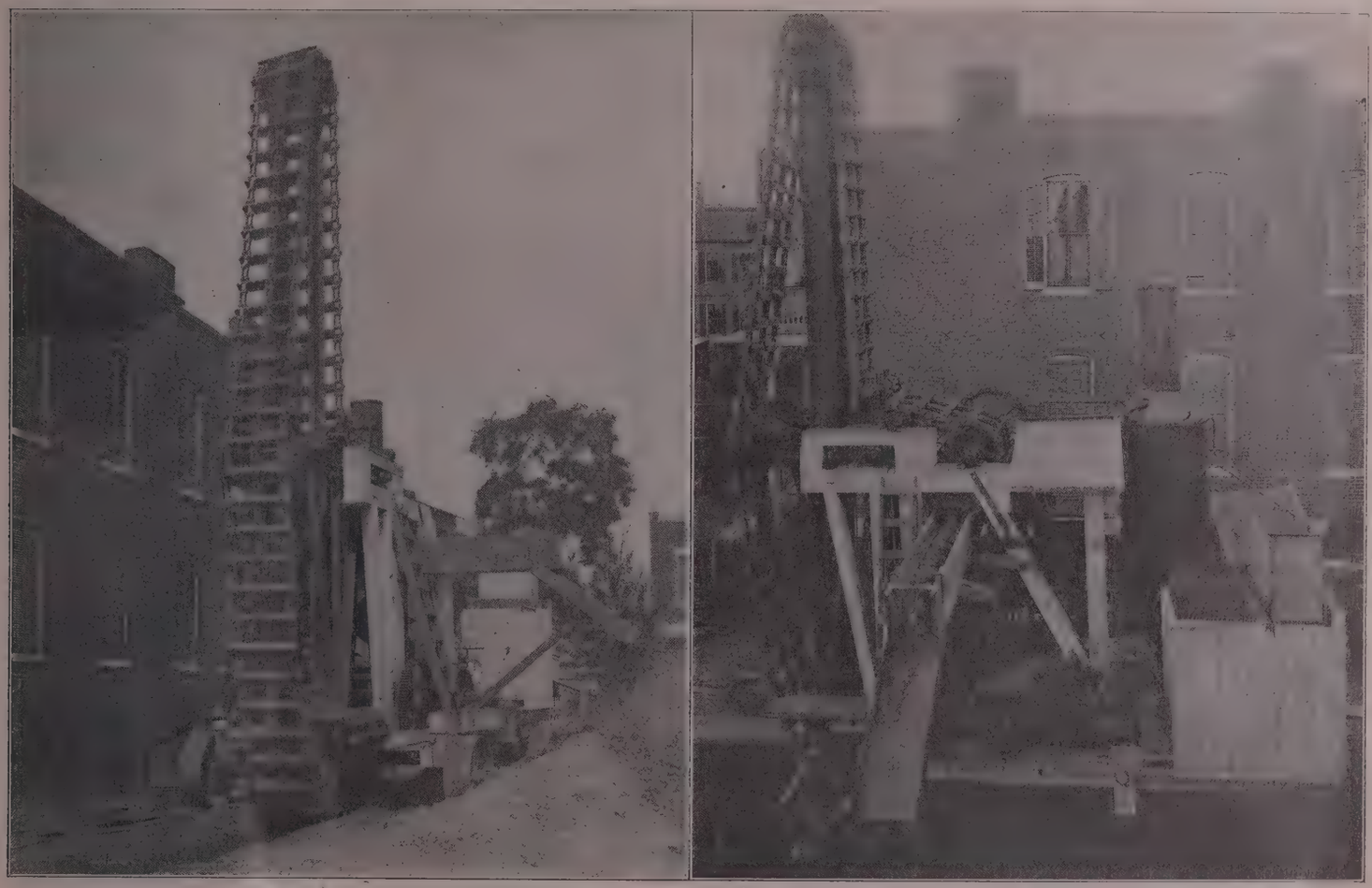
Since 1893 the corporation of Edinburg has carried out various improvements in the unhealthy areas of the city, acquiring slum properties, demolishing the old houses if not capable of being made fit for human habitation, and building tenements to be let at low rentals. The market value has been paid for all slum properties taken either by agreement with the owners or compulsorily, under the housing of the working classes act. The law requires that where more than ten houses (the term "house," as used here, meaning a flat or separate division of a flat) occupied by persons of the laboring classes are scheduled for demolition, new houses shall be provided for the persons so displaced unless the secretary for Scotland is satisfied that ample accommodation is otherwise available within a reasonable radius. In twelve years 1,608 houses have been demolished and 662 erected. Of these new houses, 289 are of one apartment, 36 of one apartment and bed closet, 329 of two apartments and bed closet, and 8 others not recorded. The cost of the erection of each house has ranged from £100 to £190. Tenants of one-apartment houses pay 60 cents a week rent, of two-apartment houses $1 a week. The financial aspect of the housing scheme is altogether unfavorable. There has been a loss, which has had to be met out of the rates or taxes.

The net amount of capital expended for dwelling-house improvement down to May 15, 1905, was $826,555, and the valuation of the property, as appearing in the city's books, is $465,262, leaving a deficiency of $361,293. The principal cause of this deficiency, it is said, has been the large prices which the corporation has had to pay for the sites. These, with cost of clearance, have varied from $9.73 to $23.84 per square yard. The expense of managing and repairing the houses has been remarkably heavy, no less than 40 per cent. of the rents collected. The improvement scheme committee of the town council, while justly claiming that the clearances have had a salutary effect on the health of the city, have considered the advisability of the corporation getting rid of all holdings of this class of property, stringent terms to be laid down as to the sanitary condition in which they must be kept, so as to prevent their relapsing into a slum condition a few years hence. It is now stated by the committee, in a report to the town council, that "the emergency which compelled the corporation to provide the houses has passed away, considerable difficulty having been experienced in getting them fully let, and there seems no reason why the corporation should continue to be encumbered with such property." In short, the municipal effort in Edinburgh to solve the housing problem has been a costly experiment from first to last, both in providing and managing the tenements.

A NEW TRENCH EXCAVATING MACHINE.

The accompanying illustrations give two views of the first of a new type of trench excavating machine to be constructed by the Helm Trench Machine Co., of St. Louis. The digging arrangement is an endless chain with buckets, dumping the excavated material into a hopper from which it is discharged to one side of the machine. The digger handle which holds the chains and buckets in place is vertical and pivoted on sills allowing the bottom end to swing. At the lower sills of the machine, the digger handle is held by springs which keep the buckets up to the work, and, in case of striking a rock, allow the buckets to pass over and around it. The digger handle is raised and lowered with a hoisting drum as wanted, without loss of time, and allows the trench being dug to any depth desired.

With the experimental machine shown in the illustrations, the builders dug 560 lin. ft. of sewer trench 30 in. wide by 19 ft. deep, and had no trouble with the digging end; in fact, they were more than pleased with the digging end but found the 8x10-in. engine was light and the balance of the machinery and frame were entirely too light and weak. But with all these drawbacks they dug as much as 30 cu. yd. in one hour, and the best run was 70 ft. linear in one day. The trench was in stiff, wet, yellow clay with 3 ft. of fire clay and strata of gravel and small boulders in bottom. The new machine will dig a trench of any depth up to 25 ft. (or 30 ft. or more if desired), in one cut and any width from 24 to 36 in. by change of bucket, and the makers guarantee it to excavate 70 cu. yd. and upwards in favorable soil. This machine will dig in any kind of soil, wet or dry, from sand to hardpan, and as the bracing of the trench can be done within 4 ft. of the cut or breast, it can be used in very poor soil without danger of sides caving in. The new machine will be built entirely of steel and iron, will have Scotch boiler and double reverse link, 8¼x10-in. stroke horizontal engines, with danger from breakage practically eliminated, easily operated, will require but one engineer and one fireman, and will have a belt conveyor extending back to refill trench.



TWO VIEWS OF A NEW TYPE OF TRENCH-DIGGING MACHINE RECENTLY TESTED IN ST. LOUIS.

The Standard Roller Bearing Co., Philadelphia, Pa., has just started the erection of a brass and iron foundry, 60 x 125 ft., two stories in height. Their crucible steel casting plant started operating this week. The size of this building is 60 x 95 ft.

THE NATIONAL ASSOCIATION OF CEMENT USERS.

Last week an announcement was made in this journal at the request of the president of the National Association of Cement Users, that the Association would meet at Columbus instead of Milwaukee, as originally proposed. It now appears that the meeting place after all will be Milwaukee. The secretary of the organization, Mr. C. C. Brown, of Minneapolis, has issued the following notice concerning the convention.

The information about attendance and exhibitors at the second convention of the National Association of Cement Users, to be held in Milwaukee, Jan. 9, 10, 11 and 12, indicates that there will be many more at the convention than were present at the Indianapolis convention, and that the exhibits will be greater in number and more varied in character. Already the contracts for space very nearly equal the entire space occupied at Indianapolis, and a number of contracts will doubtless result from the inquiries on hand, in addition to those which are made after intending exhibitors reach the convention.

The local committee at Milwaukee has been having some difficulty with its contracts for convention facilities, and it has been necessary to change the arrangements heretofore announced in the circulars sent by the secretary. The convention sessions will be held in the West Side Turner's hall, which is a most excellent auditorium, capable of holding any number of members likely to be present. The lighter exhibits will be located in the same building, and there is ample space for all those which have already contracted for space, with opportunity for additions. The heavier exhibits, including the concrete block machines, the mixers, gasoline engines, etc., will be located in the Freie Gemeinde hall, which is located on the same block. This building has capacity for all of this class of exhibits which are likely to come to the convention.

The headquarters have been moved, on the recommendation of the local committee, to the Republican hotel, which is on the same block as the halls, and is an excellent hotel. The building for the heavy exhibits is on the route from the headquarters to the convention hall, and all are easy of access from each other. The headquarters hotel is about two blocks from the city hall and the hotels in that neighborhood. All the railroad passenger associations but the New England have granted the usual rate of one and one-third fares for the round trip, on the certificate plan.

Following is the program as it is now arranged in order of presentation to the convention: Tuesday afternoon, Jan. 9, business session; papers by Sanford E. Thompson on "Concrete Aggregates"; Edward Thachcer, subject not yet stated; committee reports on streets, sidewalks and floors.

Tuesday night.—President's address; stereopticon; papers by A. L. Johnson on "Steel for Reinforcement," and Ross F. Tucker on "Twenty Years of Experience in Concrete Construction."

Wednesday morning, Jan. 10, papers by C. A. P. Turner on "Cement in Building Construction"; Richard L. Humphrey on "Investigation of Cement Mortars and Concretes at St. Louis," and R. W. Lesley, subject not yet stated; report of committee on Art and Architecture by Chas. E. Watson, chairman, and possibly others.

Wednesday afternoon.—Business session, question box and topics.

Wednesday evening.—Papers by Louis H. Gibson, architect, on "Cement Block Architecture"; S. M. Woodward, U. S. Dept. of Agriculture, on "The Use of Cement and Concrete for Farm Purposes"; J. C. McClenahan on "Manufactured Stone"; report of committee on Concrete Blocks and Cement Products.

Thursday morning, Jan. 11.—Report of committee on Machinery for Cement Users, W. W. Benson, chairman, with papers by E. B. Kelley on "Concrete Mixers," J. P. Sherer on "Air Tamping and Conveying Concrete Blocks," J. F. Angell and others; paper by J. L. Mothershead on "Water-proofing," and paper by E. D. Longcope on "Uses and Abuses of Cement."

Thursday afternoon.—Papers by O. U. Miracle on "Causes of Failures in the Concrete Block Business," Richard K. Meade on "The Choice of Cement for Concrete Blocks," and S. B. Newberry on "The Manufacture of Hollow Concrete Blocks."

Thursday evening.—The Association will be the guests of the Milwaukee friends at the "Builders' Club," with speeches, illustrated talks, refreshments and all the entertainments of this large and prosperous organization.

Friday morning, Jan. 12.—Paper by E. S. Larned on "Observations on the Testing and Use of Portland and Natural Cements"; report of committee on Testing of Cement and Cement Products, E. D. Boyer, chairman; report of committee on Laws and Ordinances.

Friday afternoon.—Report of committee on Fireproofing and Insurance, by Vice-Chairman E. T. Cairns; papers by R. P. Miller on "Legislation Concerning the Use of Cement in New York City," and Will J. Scoutt on "Building Regulations of Concrete Blocks."

THE ENGINEERS' CLUB, NEW YORK.

The foundation stone of the new building of the Engineers' Club, on West Fortieth Street, New York City, opposite Bryant Park and the new Public Library, was laid on Dec. 23 by Mrs. Andrew Carnegie, whose husband declared the task well and truly done. The ceremony was quite informal, but the club was well represented by its officers and committees, including President W. H. Fletcher and Past President John C. Kafer. The architects, Messrs. Whitfield & King, were also present. Fortunately the weather cleared during the afternoon, and thus the party were enabled to inspect the building, now up to the ninth story in the steel work and to the third in marble and brick casing. The records deposited in the stone included a Bible of 1905, a club book of 1905, copies of the Herald, Tribune, Sun and Times of Dec. 23, a copy of the certificate of incorporation, a booklet of the old club-house at 374 Fifth Avenue, a half dollar, quarter dollar, dime, nickel and one cent, a card of W. L. Crow, the builder; a copy of Mr. Carnegie's letter of gift to the Engineering Societies and the Engineers' Club, a chronological history of the club, a list of members elected since the publication of the club book this year, a list of the incorporators of the club, the programme of competition for the selection of architects for the two buildings and floor plans of the new house.

BUSINESS NOTES.

Among the orders recently secured by the York Mfg. Co., York, Pa., are the following: 30-ton compression side for the Canadian Breweries, Montreal; 60-ton refrigerating plant for the Hammond Packing Co., Cheyenne, Wyo.; 60-ton compression side for the Utah Ice & Cold Storage Co., Salt Lake City, Utah; 30-ton ice plant for W. H. Craig, Chester, Pa.; 60-ton ice plant for the Citizens' Railway, Light & Power Co., Newport News, Va.; 25-ton ice plant for the Hamlet Ice Co., Hamlet, N. C.; 125-ton compression side and direct-expansion piping for East Tennessee Brewing Co., Knoxville, Tenn.; 25-ton ice plant for Weinacker Ice & Fuel Co., Mobile, Ala.; 35-ton refrigerating plant for Lord & Taylor, New York City; 20-ton refrigerating plant for the Park Chemical Co., Emporium, Pa.; 35-ton ice plant for the Kelly-Jones Ice & Cold Storage Co., Gulfport, Miss.; 35-ton ice plant for the Consumers Ice Co., Greenville, S. C.; 25-ton compression side and 15-ton freezing and distilling system for the Crysta. Ice Co., Bartlesville, I. T.; 100-ton compression side for Bartholomay Brewing Co., Rochester, N. Y.; 25-ton ice plant for John Ebner Ice Co., Seymour, Ind.; 60-ton compression side for Howell & King, the Union Brewery, Pittston, Pa.; 10-ton refrigerating plant for John Coleman, Mt. Carmel, Ill.; 35-ton ice plant for Ensley-Pratt Ice Co., Ensley, Ala.; 16,000 ft. of direct-expansion piping for the John Staunton Brewing Co., Troy, N. Y.; one pair 10 x 20 ammonia compressors for the Rome Ice Mfg. Co., Rome, Ga.; 100-ton ammonia compressor for Henry Elias Brewing Co., New York, N. Y.; ammonia condenser for Morganthaler Bros., Philadelphia, Pa.; 100-ton ammonia condenser and steam condenser for Franklin Brewing Co., New York, N. Y.; single-acting ammonia compressors for the Howard & Childs Brewery, New York, N. Y.; one pair 14 x 20 single-acting compressors for the Enterprise Brewing Co., Fall River, Mass.; one pair of 20 x 32 single-acting compressors for the Consolidated Ice Co., Pittsburg, Pa.; 10-ton freezing and distilling system for F. C. Lucas, Lock Haven, Pa.; 125-ton ammonia condenser for Henry Claus Brewing Co., New York City; 6-ton freezing tank for the Flower City Brewing Co., Rochester, N. Y.; one pair of 15 x 23 single-acting compressors for the Germania Brewery, Charleston, S. C.; 10-ton compression side and 4-ton ice plant for Agar, Cross & Co., New York, for export to Buenos Aires; 180-ton ammonia condenser for Chris. Feganspan Brewery, Newark, N. Y.

Wm. B. Scaife & Sons Co., Pittsburg, Pa., have been awarded the contract for all the structural steel work in connection with the new buildings being erected by the Midland Steel Co., at Cook's Ferry, Pa. This work involves a large tonnage in structural steel, and it is said that additional structures will be erected in the near future.

The American Blower Co., Detroit, Mich., report that the past few months have been exceptionally busy ones for them, their books showing outfits for heating and ventilating fifty schools and other public buildings, between thirty and forty manufacturing plants, and a large number of dryers for brick, lumber and other materials. They also report a large business in the installation of mechanical draft plants. Among the prominent customers of this company during the past few years is the Standard Wall Paper Co., Sandy Hill, N. Y. The experience of this company with the apparatus furnished is set forth in the following letter to the American Blower Co.: Replying to yours of the 7th, would say that we have two of your 100-in. fans in operation in our Sandy Hill plant, which are used for drying purposes, one of which is operated with a motor, and the other with one of your Type A engines, and we are pleased to say that they are in all respects the most satisfactory equipment of the kind that we ever had anything to do with. The heater and the fan, with the engine just received, were put in complete operation in thirty-six hours after they were received; everything seemed to fit perfectly.

Robb-Mumford Boiler Co. announces its removal from Cambridge, Mass., to its new plant at South Framingham, Mass., to which point all correspondence should be addressed in future.

Milliken Brothers, Inc., New York, announce in connection with their new open-hearth steel plant and rolling mill at Staten Island that the contract for the boilers, amounting to 4,000 h.p., has been placed with the Babcock & Wilcox Co.; contract for the electrical traveling cranes, of which there are quite a large number, has been placed, partly with the Morgan Engineering Co., and partly with Messrs. Manning, Maxwell & Moore, Inc., agents for the Shaw Crane Co. The contract for the large machines for the mills has been placed with the Southwark Foundry & Machine Co., of Philadelphia.

Contract has been awarded to the American Concrete-Steel Co., of Newark, N. J., for the erection of a new steel foundry building, 160 x 210 ft.; also a new producer house, 40 x 90 ft., and extension to present foundry building, 1,100 x 100 ft., by Benj. Atha & Co., of Newark, N. J. The cost involved is about $80,000.

CLAIMS AGAINST THE GOVERNMENT FOR DELAYS.

Another case for the William Cramp & Sons Shipbuilding Co. has just been argued before the Court of Claims. This is the claim for damages under the contract for building the Alabama. The contract was executed Sept. 24, 1896, and provided that the Alabama should be completed in three years, the Government furnishing the armor plate. The contractors were ready for the armor as early as November, 1897, but the United States did not even make its contract with the armor plate makers until June 8, 1898, and the first delivery of armor was not made until Jan. 4, 1899. This caused, the company claims, a great loss to them by reason of the delay.

The total claim is for $76,443.38. The principal item of this claim is wharfage, $26,324.11, and other considerable items are electric lighting, $16,049.76; insurance, $7,790.32; keeping the vessel clean, $5,811.69.

The Government defends against this by showing that the claimant, on receiving final payment, executed a release, which is stated to be a release in full of all claims. The claimant answers by saying that this did not release unliquidated damages for delay, but only released such items of claim as might have been made before the Secretary of the Navy. The Government says that the company was behind on this work in the contract term, and could not have finished in time, even if the armor plate had been delivered to it. It says also that the delay was not altogether due to the United States in furnishing the armor, but to other causes, such as the rush of other work in the yard, and a nine months' strike. The Government also makes the defense that the contract provided specifically that in case of delay not the fault of the contractors the only remedy of the contractors should be an extension of time, and that they have no right to an action for damages. The Government denies that there is any liability for wharfage, the largest item of the claim, and says that that was an incident of the extended contract. If anything is due, it says that the judgment should be limited to $19,618.27.

The case will probably be decided about the first of January.

THE STANISLAUS ELECTRIC DEVELOPMENT.

Announcement is made of the successful financing of a large hydro-electric enterprise to be developed by the Stanislaus Electric Power Co. in the central portion of California. Actual construction has already commenced and the work will be pushed to completion as fast as possible.

The project includes the construction of a power plant on the middle fork of the Stanislaus River at Subletts Crossing, about six miles from the town of Murphys, Calaveras County, and the establishment of storage reservoirs at the head waters of the river; a diverting dam near Sand Bar Flat in Tuolumne County a flume and ditch system 15½ miles long, with a capacity of 300 cubic feet of water per second; a large equalizing reservoir above the power house site; a system of pipe lines, which will deliver the water to the power house under a head of 1,500 ft.; a power station, equipped with water wheels and electrical apparatus of a capacity of 20,000 kw.; and a transmission system which will provide for the distribution of power to a market within a radius of 150 miles of the power house. A pressure pipe system will also deliver water across the Stanislaus River canyon for distribution in Calaveras County.

The proposition is backed by strong interests in Boston, Chicago, New York and San Francisco. Messrs. Tucker, Anthony & Co., of Boston; Mr. Frederick L. Eldridge, first vice-president of the Knickerbocker Trust Co., and Mr. C. C. Cuyler, of Cuyler, Morgan & Co., of New York, are syndicate managers. The Knickerbocker Trust Co. of New York are the trustees for the bond issue, which is to be $10,000,000.

The engineering and construction work is to be in charge of Sanderson & Porter, engineers, of New York City. The water rights, reservoir sites, timber land and other properties have been acquired by the Stanislaus Electric Power Co. from Mr. Beach Thompson, of San Francisco, who will be associated with the enterprise. Messrs. H. P. Veeder and James K. Moffitt, of San Francisco, and Mr. Harvey P. Goodman, of Napa, Cal., are also interested.

PROGRESS ON THE NEW YORK, NEW HAVEN & HARTFORD LOCOMOTIVES.

During the past week the first of the twenty-five Westinghouse single-phase electric locomotives ordered by the New York, New Haven & Hartford Railroad for operation on their lines between Woodland and the Grand Central station in New York City was received from the Baldwin Locomotive Works, Philadelphia, by the Westinghouse Electric & Manufacturing Co. at its works at East Pittsburg. The Baldwin Co., working jointly with the Westinghouse Co., constructs the locomotives and the Westinghouse Co. provides the electrical equipments. Each locomotive is to be equipped with four Westinghouse single-phase railway motors of the straight series gearless type and also with the unit switch system of multiple control. It is expected that this first locomotive will be ready to run by the middle of January, 1906.

PERSONAL NOTES.

Mr. Oliver W. Childs has been appointed bridge engineer of St. Louis, succeeding Mr. Carl Gayler.

Mr. J. W. Wilcox has been re-elected city engineer of Macon, Ga.

Mr. Frank B. Cobb has been reappointed City Engineer of Chicopee, Mass.

Major Henry Taylor, Corps of Engineers, U. S. A., has been ordered to report to the Chief of Engineers, at Washington.

Mr. J. A. Paige has been appointed assistant city engineer of Baltimore, in charge of new street paving, bridges and grades.

The Board of Public Service of Cincinnati is stated to have determined on Mr. Charles N. Danenhower as its chief engineer for 1906.

Mr. Hugo Diemer, consulting engineer, has opened offices in the Commercial Club Bldg., Indianapolis, and will make a specialty of investigations for the improvement of methods of manufacturing.

Mr. J. B. Elliott has been appointed master mechanic of the Canadian Pacific lines east of Fort William, and Mr. W. S. Painter has been appointed architect of the entire railway system.

Mr. Robert F. Wetz has moved his offices to the National Bank Bldg., Allentown, where he will continue to give his attention to the design of cement and sand-lime brick factories and machiery.

Br. J. E. Zalles, secretary of the Bolivian National Railways commission, has temporarily taken over the work of chief engineer of surveys of the National lines, succeeding Mr. W. L. Sisson. His address is La Paz.

Mr. John Sturgess, general manager of the Sturgess Governor Engineering Co., which has sold out to the Ludlow Valve Mfg. Co., will become general manager of the governor department of the latter company, with offices in Troy.

Capt. Spencer Cosby, corps of engineers, U. S. A., has relieved Lieut.-Col. Richard L. Hoxie, of the supervision of the water supply system of the District of Columbia and the river and harbor improvements of the Potomac River. For the last two years he has been serving in the Philippines.

Lieut. John H. Poole, Corps of Engineers, U. S. A., has been appointed superintendent of the State, War and Navy Building, at Washington, succeeding Rear Admiral George W. Baird, U. S. A., retired, the latter's health having failed to such an extent that he asked some time ago to be relieved. Lieut. Poole has been serving in the Philippines for the last two years.

Mr. John C. Brackenridge, who retires from the office of Commissioner of Public Works of Brooklyn on Jan. 1, will become president of the Rossiter-McGovern Construction Co., Whitehall Bldg., New York. Mr. Brackenridge was connected with the Brooklyn Rapid Transit system for many years before becoming commissioner.

The Washington Society of Engineers was organized Dec. 19, with Admiral C. W. Rae as president, Major John Biddle vice-president, Mr. L. D. Bliss secretary, and Mr. D. E. McComb treasurer. The directors are C. W. Hays, chief geologist of the U. S. Geological Survey; B. R. Green, superintendent, D. S. Carll, W. A. McFarland, F. H. Newell and O. H. Tittman. The society is stated to have about 300 members to start off with.

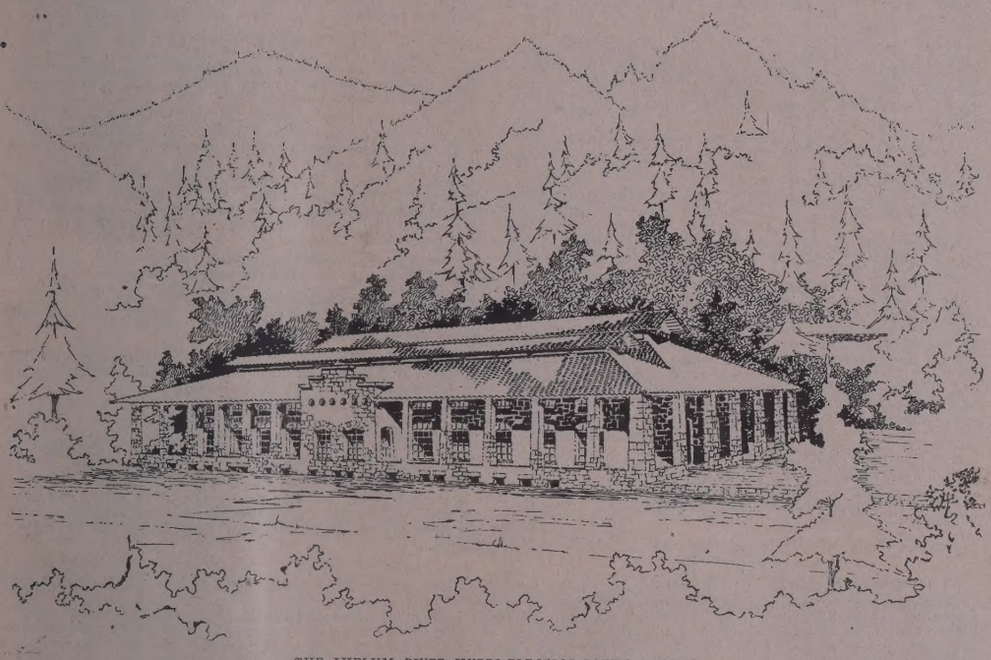
Matthew Patterson Wood, who died in New York on Dec. 23, is best known as the author of books and papers on paints, written after illness compelled him to retire from active work. Before this, however, he was a very busy man. During the Civil War he was superintendent of motive power on the U. S. military railways under Gen. Herman Haupt, and held the rank as major of engineers.

JHELUM RIVER HYDRO-ELECTRIC POWER INSTALLATION IN BRITISH INDIA.

C. W. Whitney.

The government of British India has for some time pursued a broad-minded policy in developing the latent possibilities of the immense and valuable country over which it exercises sovereignty, and its officials have interested themselves in providing for the future welfare and enlightenment of the native inhabitants. Among other laudable projects, which the government has instituted, has been the commissioning of some of the most capable Royal Engineers to plan for and construct public works, such as would aid in the general advancement of the native industries and the development of the commerce of the country.

The first notable project undertaken for the generation and distribution of electricity was that of the Cauvery Power Scheme, located in Mysore State in Southern India. Work on this plant was started in 1900, the initial installation being completed after many difficulties in June, 1902. About a year ago, the second installation or extension of the plant, consisting of 3,610 kilowatts generator capacity, was completed. This increased the possible output of the entire plant to 7,920 kw, making it the largest hydro-electric installation now operating in Southern Asia, if not on the entire continent.



THE JHELUM RIVER HYDRO-ELECTRIC POWER PLANT.

The chief credit for the completion of the Cauvery Power plant is due to Major A. J. de Lotbiniere, R. E., Deputy Chief Engineer of the government of Mysore, who not only conceived the plan of the installation, but successfully arranged for the financing of the entire project, overcoming prejudices that would have deterred a man less sound in his convictions. He afterwards arranged for the purchase of the entire electrical and hydraulic equipment and supervised its installation.

The power scheme next to be undertaken after the Cauvery is the Jhelum Power Installation on the Jhelum River in Kashmir, in Northwest India. This power plant is to be installed near Rampur, about 50 miles below Sprinager, where a 6-mile conduit will give a head of water at the plant of about 400 ft. The present plans call for an installation of about 20,000 h.-p.

It is planned to use the power for operating the Kashmir section of the Jhelum Valley Railway electrically along its entire length of 180 miles. A single-phase system of traction will undoubtedly be installed. Possibly the most important immediate use to which the power will be put will be in operating dredgers for the purpose of deepening the Jhelum River in the Kashmir Valley, and thus minimizing the floods, which, under existing circumstances, periodically devastate the entire country. The contemplated plant will also allow of the reclamation of a very large tract of land, and permit of the storage of water in Wular Lake above the power plant for sale to the Punjab Irrigation Department. Another important use of the power will be for operating the large silk factory at Sprinager and also for supplying with current the electrical water heaters in the silk mill. In addition, the power will be utilized for other industrial purposes and for lighting in Sprinager and in Abbottabad, Murree and Rawalpindi, prosperous towns in the British Province of Hazara, lying to the west of Kashmir.

After successfully completing the preliminary arrangement for carrying on the important work connected with the Jhelum Power Installation, Major de Lotbiniere was instructed last May, by the Jammu and Kashmir State Council, acting for the Maharajah of Jammu and Kashmir, to proceed to Europe and America in order to interview the leading hydraulic and electrical manufacturers and to ask those selected to bid upon the machinery and materials for the plant. Carrying out these instructions, he visited the works of those leading manufacturers on both continents who were considered for the work and personally inspected their manufacturing establishments, as well as power plants in which their machinery was operating.

As a result of this careful investigation, Major de Lotbiniere, who had full powers for the acceptance of the tenders submitted, has recommended to his Government that the contracts for the entire hydraulic and electrical equipment be placed with firms in the United States. The contract for the hydraulic equipment was awarded to the Abner Doble Company of San Francisco, U. S. A., and calls for the hydraulic plant complete from the forebay to the tailrace, including the intake, valves, pressure pipes, pressure-pipe thrust blocks, interior piping, water wheels and nozzles, hydraulic governors, and all apparatus and materials are to be delivered at the Port of Karachi, India.

The gravity conduit line for the power plant will be approximately 34,000 ft. in length and for the upper 8,500 ft. will consist of an excavated ditch lined with masonry. The remaining portion of the water channel will consist of a rectangular flume, or a wooden stave pipe such as has been installed so successfully in connection with plants of this character on the Pacific Coast. The flume will have a capacity of over 500 cu. ft. per second.

The forebay at the end of the gravity line and at the head of the pressure pipes will be constructed of masonry and will be provided with special headgates. The sliding elements of the intake gates will be of timber, all iron and metal parts necessary for the construction of the gates being furnished by the hydraulic contractor.

The pressure lines will consist of riveted steel pipes designed with a factor of safety of five, each supplying one of the hydro-electric units. For each pipe line a standpipe and two special vacuum valves will be provided in order to protect the pipe against injury in case the water should be drawn out suddenly.

At the lower end of each pressure line the last length of pipe will terminate in a flange which will be bolted to a massive cast-iron thrust block that will rest on a heavy cast-iron sole plate or base. The latter will be mounted on a substantial masonry foundation and held in position by anchor bolts. This fitting will be designed to take the entire hydraulic thrust of the pipe, an ample factor of safety being allowed so that under the most severe conditions there will be no strain on the branch piping in the interior of the power house. Each pressure line will consist of a riveted steel pipe varying in diameter from 30 to 36 in. and a 54 to 36-in. taper pipe, 10 ft. long, at the upper end. The pipes will be 790 ft. in length and will deliver the water under an effective head of 400 ft.

The interior piping of the power house will consist of welded pipe with welded flanges, all piping and fittings beyond the thrust block being designed with a factor of safety of 10 and subjected to a test pressure of 1½ times the working pressure for a period of five hours.

Twelve main units and three exciter units have been planned for the equipment of the power house. Each main unit will consist of a Doble Tangential Water Wheel with automatic oil-pressure governor delivering 1,765 brake h.-p. to the shaft, under an effective head of 400 ft. Each wheel will be direct connected to a 1,000-kw. alternator, the speed of the unit being 500 r.p.m. The exciter units will each consist of a Doble Tangential Water Wheel delivering 285 brake h.-p. to the shaft under an effective head of 400 ft. The speed of the exciters will also be 500 r.p.m.

The hydro-electric units will be of the Doble standard two-bearing type, the wheel runner being fastened on the end of the shaft. For each of the main units the Doble Company will furnish a high-carbon, open-hearth steel forged shaft and two bearings of a special ring-oiling type provided with revolvable bearing shells. The exciter water-wheel runners will be mounted on the extended ends of the exciter generator shafts.

The water wheels will be equipped with ellipsoidal buckets, needle regulating nozzles and centriful water guards. The regulation of the main units will be effected by means of hydraulic governors operating jet deflectors. For the exciter units hand regulation will be provided by means of the needle nozzles. The gate valves for each wheel will be of special construction with outside screw and yoke, bronze-mounted, with by-pass.

The power house will be of solid masonry construction end of the shaft. For each of the main units the Doble tropical sun. A double steel roof will be provided and two traveling cranes will be installed for handling the machinery. The transformers will be installed in a bay of the main building or in a separate structure.

The conditions under which the plant will be installed are decidedly out of the ordinary as compared with similar work in this country. The specifications for the electrical and hydraulic equipment stipulated that no single piece of machinery should weigh more than four tons when packed, for the reason that there is 200 miles of road transportation, including a lift over a range of mountains 8,000 ft. high. Transportation in that section of the country is limited to bullock cart, and no single piece of machinery heavier than four tons can be transported, a total of five tons, including the trollie (cart), being the maximum weight that can be hauled over the mountains.

Portland cement costs $7.50 per bbl. delivered at the site, making its use prohibitive for heavy concrete work. However, there is plenty of natural rock in the vicinity, so masonry construction will be used for the walls of the power house and for the foundations of machines, intake, forebay, etc.

The entire hydro-electric installation will be constructed, erected, tested and placed in operation under the supervision of Major A. J. de Lotbiniere, R. E. Major D. Fraser, R. E., and Capt. Thomson, R. E., will act as his engineering representatives in London. Mr. A. C. Jewett, formerly of the General Electric Company, will serve as installing engineer for the Government. Mr. Jewett was connected with the installation of the Cauvery plant and his selection as erecting engineer for the Jhelum River installation comes as a well-deserved recognition of his ability.

TRADE PUBLICATIONS.

The Trump Manufacturing Co., Springfield, Ohio, has issued a revised folder of its turbines designed specially for small streams with a limited amount of water. These small wheels are often very useful, but they have only recently come into the favor they deserve. The same company has also revised its catalogue of self-contained side-crank engines and internally fired and standard shell boilers.

The Electro-Dynamic Co., 11 Pine St., New York, gives in its circular 18 a number of illustrations of interpole variable-speed motors applied to milling machines, lathes, centrifugal pumps, boring mills and electro-plating outfits. The motors for driving centrifugal pumps are of 50 and 100 h.p. and their use with this class of pumps is deserving of particular attention on account of the widely varying load which such apparatus must carry.

Among the mechanical devices recently introduced to save labor in foundries is the pneumatic screen shaker made by the Hanna Engineering Works, 820 Elston Ave., Chicago. This consists of a screen which is reciprocated rapidly by a pneumatic device consisting of a cylinder, piston and suitable valves. It is run by air or steam and is made in a number of different forms, fully described in a catalogue just issued by the company.

CONTRACTING NEWS

OF SPECIAL INTEREST TO CONTRACTORS, BUILDERS, ENGINEERS AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Santa Monica, Cal.—J. C. Hemingway, City Clk., writes that the citizens have not yet voted on the issue of bonds for water works; probable cost of construction, $250,000. Thos. H. James, City Engr.

Chicago, Ill.—Bids will be received until Jan. 12 by the Dept. Pub. Wks. (J. M. Patterson, Comr.) for furnishing material and constructing foundations for a 25,000,000-gal. pumping engine at the Chicago Ave. pumping station.

Casey, Ill.—B. B. Sturdevant, City Clk., writes that a franchise for water works has been granted to W. W. Jamison and W. E. Stathers, oil operators.

Indianapolis, Ind.—The Indianapolis Water Co. is reported to be considering plans to increase the water supply for Irvington. Probably a reserve pumping station will be constructed.

**Muskogee, Ind. Ter.*—Cook & Son, of Junction City, Kan., have secured the contract for constructing 10 miles of sewers 8 to 36 in., 7 miles of 6-in. water mains, 70 hydrants, 50 valves and boxes (bids opened Dec. 21). Engineer, M. A. Earl, First Natl. Bank Bldg., Chicago, Ill.

Okmulgee, Ind. Ter.—Plans and specifications are being prepared by Burns & McDonnell, of Kansas City, Mo., for water and sewer extensions.

Chickasha, Ind. Ter.—An election will be held Jan. 16 to vote on issuing $60,000 bonds for water and sewer extensions, for which Burns & McDonnell, of Kansas City, Mo., are preparing plans.

Burt, Ia.—The citizens are reported to have voted to issue $7,000 bonds for water works and a sewerage system.

Sioux City, Ia.—Surveys are now being made for the Perry Creek conduit to cost $250,000 and the Beacon Creek conduit to cost $60,000. The matter will be submitted to the voters in March. J. M. Lewis, City Engr.

**Hammond, La.* — Contracts for constructing water works and a drainage system (bids opened Dec. 6) are reported to have been awarded as follows: Construction Work, Roy Stookey, of Belleville, Ill.; pipe, U. S. Cast Iron Pipe & Fdry. Co., Pittsburg, Pa.; hydrants and valves, Herron Pump & Fdry. Co., Chattanooga, Tenn.; tower and tank, Des Moines Bridge & Iron Works, of Des Moines, Ia., and artesian wells, Edw. C. Way, of Hammond.

Chicopee, Mass.—The Bd. of Aldermen on Dec. 18 defeated the order authorizing the Mayor to issue bonds to extend the water system to Fairview.

Salem, Mass.—The Water Boards of Salem and Beverly are reported to have held a joint meeting at Salem on Dec. 15, at which Engineer Freeman C. Coffin, of Boston, submitted a report on the water supply, recommending a filtration plant, at a cost of $300,000.

Newburyport, Mass.—The Water Comrs. are stated to have voted to recommend that the City Council petition the Legislature for permission to expend $75,000 for improving the water supply. The taking of water from Artichoke River, which will be purified by filtration, the construction of a large covered storage basin at Jackman Ravine, and the substitution of cast iron main for the cement lined main on Water St., below the City R. R. crossing, are among the improvements under consideration. Engineer, Freeman C. Coffin, of Boston.

Minneapolis, Minn.—The City Water Works Com. is reported to have decided to procure bids for iron pipes, valves, hydrants and special castings, that may be required during 1906. The cost of material for the year 1905 was about $60,175.

Huntley, Mont.—Bids were opened on Dec. 15 at the office of H. N. Savage, Superv. Engr., Billings, for the construction of main canal, laterals and ditches, involving the excav. of about 640,000 cu. yds. earth, some rock excav., and furnishing and constructing various structures, to be known as the Huntley project. This work is divided into six schedules. Piper Bros. Co., of Pueblo, bid for Schedule 3, which calls for various bridges, $8,683, and the Midland Bridge Co., Kansas City, Mo., $16,331; Piper Bros. submitted the only bid for Schedule 4, at $15,443, which calls for timber culverts, turnouts and trestles. This company also submitted the only bid for Schedule 5, which calls for concrete structures, setting gates, etc., at $11,186. The only bid received for Schedule 6, which calls for reinforcing and structural steel gates, girders and lifting devices was submitted by the New Jersey Fdy. & Machine Co., of New York, N. Y., for $10,588.

The following are the bids received for Schedules Nos. 1 and 2: (*a*) Piper Bros. Co., Pueblo, Colo.; (*b*) Nick Hughes and Nels Olsen, of Butte:

	a	*b*
Schedule 1—		
141,000 cu. yds. excav. Class I	$0.14	$0.20
250 cu. yds. excav., Class II	.38	.50
250 cu. yds. excav., Class III	.75	2.50
65 lin. mile ditching, type 5	120.00	200.00
12 lin. mile ditching, type 10	135,00	200.00
24 lin. mile waste-water ditches, type 8	165.00	340.00
11 lin. mile waste-water ditches, type 30	555.00	1,160.00
100 cu. yds. paving	3.98	5.00
250 cu. yds. riprap	3.98	5.00
200 cu. yds. coarse gravel	1.25	3.00
Totals	$41,150	$67,620
Schedule 2—		
115,000 cu. yds. excav., Class I	$0.14	$0.20
400 cu. yds. excav., Class II	.38	.50
400 cu. yds. excav., Class III	.75	2.50
66 lin. mile ditching, type 5	120.00	200.00
12 lin. mile ditching, type 10	135.00	200.00
24 lin. mile waste-water ditches, type 8	165.00	340.00
10 lin. mile waste-water ditches, type 30	555.00	1,160.00
250 cu. yds. paving	3.98	5.00
400 cu. yds. riprap	3.98	5.00
50 cu. yds. coarse gravel	1.25	3.00
200 cu. yds. rubble wall	3.98	5.00
200 cu. yds. concrete, Class I	5.45	10.00
Totals	$40,137	$65,960

**Avalon, N. J.*—G. W. Kates, Chmn. Street Com. Boro. Council, writes that A. G. Rice & Co., of Sea Isle City, has secured the contract for 7,000 ft. 4-in. c.-i. water pipe, fire hydrants, etc. (bids opened Dec. 21).

Haddonfield, N. J.—The citizens are reported to have voted in favor of municipal water works.

Roswell, N. M.—Bids will be received at the office of the U. S. Reclamation Service, at Roswell, until Feb. 1 for the construction and completion of canals and laterals, involving about 100,000 cu. yds. earthwork and 1,000 cu. yds. overhaul at a point 8 miles s. w. of Roswell, as advertised in The Engineering Record.

Carlsbad, N. M.—The Secretary of the Interior at Washington, D. C., is reported to have approved the expenditure of $600,000 for the Pecos Valley reclamation project at Carlsbad. It is proposed to construct a dam on Pecos River and irrigate about 20,000 acres of land during 1906.

Gallup, N. M.—F. W. Meyers, Town Clk., writes that bids will be received Jan. 6 for increasing the capacity of the water works; probable cost of work, $10,000.

Canastota, N. Y.—Water bonds amounting to $69,000 are reported sold.

Brooklyn, N. Y.—The Bd. of Estimate is reported to have on Dec. 22 appropriated $60,000 for the improvement and development of the Jamaica pumping station.

The Bd. of Aldermen is stated to have on Dec. 26 passed an order authorizing John T. Oakley, Comr. of Water, Supply, Gas and Electricity, N. Y. City, to expend $30,000 for 3 centrifugal pumps for Brooklyn without public letting.

Albany, N. Y.—Specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for pumping engines for the Quackenbush St. Station, bids for which will be received by the Bd. of Contract and Supply until Jan. 15. Wallace Greenlach, Supt. Bureau of Water.

Lockport, N. Y.—E. S. Bennett, City Clk. writes that the citizens voted Dec. 19 to take water from Niagara River. The Tonawanda Creek proposal was also favorably voted upon. Cost of proposed plant reported to be about $500,000.

Troy, N. Y.—Local press reports state that bids were opened on Dec. 19 by the Bd. of Contract and Supply for building a municipal filtration plant, with auxiliary pumping plant and two standpipes; also laying water mains. Bids were submitted on six different contracts, as follows:

Contract No. 1—Excavation and grading of filter, etc.: Chas. D. Beckwith, $98,098; time required to complete work, 180 days. J. W. Bishop Co., $130,512. T. H. Dumary & Co., $69,512 (2 years).

Contract No. 2—Pipe laying: Chas. D. Beckwith, $53,980 (100 days); T. H. Dumary & Co., $51,141.75 (2 years).

Contract No. 3—Stand pipes: Chicago Bridge & Iron Co., $24,926 (Nov. 15, 1906); T. H. Dumary & Co., $25,051 (two years).

Contract No. 4—Pumping plant: A. D. Granger Co., $59,900 (12 mos.). This bidder guarantees the duty of 90,000,000 ft.-lbs. per 1,000 lbs. of steam; also makes a bonus of $100 per 1,000,000 ft.-lbs. for any duty above 95,000,000 ft.-lbs. and agrees to forfeit $100 per 1,000,000 ft.-lbs. should duty fall below 85,000,000 ft.-lbs. T. H. Dumary & Co., $45,270 (2 yrs.), Worthington engines and Franklin boilers. Henry R. Worthington Co., Inc., $45,270 (7½ mos.). Duty guaranteed 80,000,000 ft.-lbs. per 1,000 lbs. of steam consumed by engine. The Platt Iron Works Co., $47,465 (7 mos.). Duty guaranteed, 110,000,000 ft.-lbs. per 1,000 lbs. of steam.

Contract No. 5—Filter plant: J. W. Bishop Co., $289,037; T. H. Dumary & Co., $229,889 (2 yrs.).

Contract No. 6—Duplication of stream crossings on Tunkhannock pipe line; T. H. Dumary & Co., $17,788 (2 yrs.).

Carrington, N. D.—It is reported that an election will probably soon be held to vote on issuing $10,000 bonds for a water supply.

Arlington, N. D.—The Council is reported to be considering the issue of bonds for water works.

Cincinnati, O.—Bids will be received until Jan. 30 by the Bd. Trus., Comr. Water Wks. (Aug. Hermann, Pres.) for constructing buildings, foundations and other work for the Western Hills Pumping Station.

Oklahoma City, Okla.—Press reports state that bids will be received until Jan. 10 by the City Council for $450,000 bonds for water works and sewerage system.

Watonga, Okla.—See "Power Plants, Gas and Electricity."

Dufur, Ore.—It is stated that bids will be received until Jan. 12 by the Bd. Water Comrs. (E. A. Griffin, Secy.) for supplying various pipes, hydrants, valves, etc.

Drain, Ore.—See "Power Plants, Gas and Electricity."

Albany, Ore.—Rhodes, Sinkler & Butcher, the new owners of the plant of the Albany Light & Water Co., are reported to have decided to construct a reservoir and filtering station, capable of filtering 150,000 gals. of water per day.

Heppner, Ore.—See "Power Plants, Gas and Electricity."

Philadelphia, Pa.—Bids will be received by the Dept. of Pub. Wks. Bureau of Filtration, until Jan. 23, for building a boiler house and chimney, as advertised in The Engineering Record.

Nashville, Tenn.—It is stated that surveys are being made for a filter plant. John T. Ahearn, Supt. Water Works.

Trezevant, Tenn.—See "Power Plants, Gas and Electricity."

Beaumont, Tex.—J. G. Sutton, City Secy., writes that the plant of the Beaumont Water Supply Co. is in the hands of a receiver. There has been some talk of city purchasing it, but nothing definite has yet been done.

Provo, Utah.—See "Power Plants, Gas and Electricity."

Elsinore, Utah.—The question of constructing water works is reported to be under consideration here.

Ogden, Utah.—See Power Plants, Gas and Electricity.

Portsmouth, Va.—The Bd. of Aldermen is reported to have decided to petition Legislature for permission to issue $500,000 bonds for the purchase and maintenance of municipal water works.

Ft. Lawton, Wash.—Bids will be received until Jan. 16 by Capt. F. A. Grant, Q. M., U. S. A., for constructing a 150,000-gal. steel tank on a 75-ft. trestle, at Ft. Lawton.

Seattle, Wash.—Local press reports state that plans and specifications are about to be prepared by Asst. City Engineer Scott, for a 1,000,000-gal. standpipe to be erected by the Water Dept. in Volunteer Park; it will cost about $60,000.

Brewster, Wash.—Edw. E. Hall, 313 7th Ave., Seattle, Pres. O'Kanogan Power & Irrigation Co., writes that L. P. Horton, of Brewster, is engineer in charge of constructing the irrigation system near Brewster; about $40,000 will be expended at present. Extensions will be made later on.

**Milwaukee, Wis.*—The following are the bids opened on Dec. 20 by the Bd. of Pub. Wks., for constructing a brick tunnel under Milwaukee River, from Knapp to Poplar Sts.: (*a*) 350 ft. 6 ft. 6 in. x 7 ft. tunnel, per ft.; (*b*) 6 ft. 6 in. x 7 ft. shaft: M. H. McGovern, Chicago, Ill., (awarded contract), *a* $35, *b* $70; R. J. Hickey, Milwaukee, *a* $70, *b* $88; A. B. Adlam, Milwaukee, *a* $86, *b* $146; F. H. Nakielski, Milwaukee, *a* and *b*, $130; Chas. Forrestral, Milwaukee, *a* $95, *b* $185.

Peterboro, Ont.—S. R. Armstrong, Secy.-Treas. Water Comrs., writes that the Water Comrs. are inquiring into the best system of filtration or purification of the water supply.

New York, N. Y.—Bids were opened on Dec. 22 by John T. Oakley, Comr. of Water Supply, Gas and Electricity, for furnishing, delivering and laying high pressure service mains and appurtenances in the northern district. The following are the totals of bids received, also unit prices on some of the items required: (*a*) J. J. Hart Co., Bway. and 175th St., $1,000,087; (*b*) Gallo & Pittelle, 127 Mulberry St., $1,065,384; (*c*) Clinton Beckwith, 49 W. 27th St., $1,026,237; (*d*) F. Bradley, 86th St. and Bway., $995,872; (*e*) Borough Constr. Co., 44 Court St., Brooklyn, $991,611; (*f*) W. J. Flanagan, Yonkers, N. Y., $946,085; (*g*) John Cornwell, Jr., 69 E. 127th St., $986,463; (*h*) Continental Asphalt Paving Co., 42 Bway., $870,710.

	a	*b*	*c*	*d*	*e*	*f*	*g*	*h*
9,900 tons straight c.-i. bell and spigot pipe	$40.00	$38.00	$40.00	$33.00	$38.00	$34.00	$40.00	$32.00
80 tons c.-i. special castings, Class A	120.00	125.00	100.00	100.00	115.20	112.00	110.00	100.00
275 tons. c.-i. special castings, Class B	75.00	125.00	100.00	90.00	103.20	71.00	100.00	90.00
410 tons c.-i. special castings, Class C	75.00	90.00	85.00	65.00	90.00	71.00	90.00	65.00
10 tons cast-steel special castings, Class A	200.00	220.00	250.00	220.00	235.20	230.00	220.00	240.00
90 tons cast-steel special castings, Class B	200.00	220.00	250.00	220.00	186.20	230.00	215.00	220.00
160 tons miscellaneous c.-i. castings	60.00	80.00	50.00	65.00	49.20	65.00	60.00	55.00
Delivery Pipe—								
14,800 lin. ft. 24-in	1.30	2.00	1.25	1.30	1.33	1.00	2.00	1.75
11,600 lin. ft. 20-in	1.25	1.75	1.25	1.20	1.10	.90	1.60	1.35
8,100 lin. ft. 16-in	1.20	1.50	1.25	1.10	.99	.80	1.40	1.05
44,500 lin. ft. 12-in	1.05	1.25	1.00	1.00	.79	.70	1.20	.70
7,300 lin. ft. 8-in	1.00	1.00	.90	.90	.70	.60	1.00	.50
350 lin. ft. 6-in. blow-off pipe	.60	1.50	.50	.75	.59	.50	.50	.45
Low Pressure Water Pipe—								
100 lin. ft. 36-in	2.00	2.00	2.00	1.50	1.50	1.00	1.20	2.25
100 lin. ft. 30-in	1.80	2.00	2.00	1.35	1.44	1.00	1.00	1.50
100 lin. ft. 24-in	1.60	1.60	2.00	1.30	1.20	1.00	.90	1.25
100 lin. ft. 20-in	1.25	1.50	2.00	1.10	.96	1.00	.80	1.00
100 lin. ft. 16-in	1.20	1.50	2.00	1.20	.72	1.00	.60	.75
500 lin. ft. 12-in	1.05	1.00	2.00	1.00	.60	.75	.50	.60
100 lin. ft. 8-in	1.00	.75	1.00	.90	.48	.75	.40	.50
300 lin. ft. 6-in	.60	.50	1.00	.75	.36	.50	.30	.50
45,000 lbs. w.-i. work, exclusive of bolts in flange joints	.05	.05	.05	.06	.08	.05	.05	.05
123,000 lbs. rolled steel shapes and reinforced steel	.05	.05	.05	.06	.05	.05	.05	.06
127,400 cu. yds. earth excav. and backfill	1.30	1.70	1.50	1.50	1.32	1.40	.40	95.00
500 cu. yds. rock excav. and backfill	4.00	6.00	4.00	5.00	3.84	10.00	5.00	5.00
2,300 cu. yds. masonry excav	4.00	10.00	2.50	3.00	3.60	4.00	3.00	4.00
175 cu. yds brick masonry	20.00	12.00	15.00	15.00	16.00	17.50	16.00	14.00
1,200 cu. yds. concrete masonry, 1:3:6	8.50	7.00	8.00	7.50	7.00	8.00	7.00	7.00
6,450 sq. yds. asphalt pavem't, inc. concrete base	2.80	2.00	4.00	4.00	4.00	4.25	4.50	4.00
27,900 sq. yds. asphalt pavem't, inc. stone block base	2.80	2.00	3.00	3.25	3.25	3.75	4.00	3.50
7,100 sq. yds. granite block pavem't, inc. concrete base	2.00	2.00	2.00	2.50	2.00	2.25	2.00	2.00
10,700 sq. yds. stone block pavem't, inc. a sand base	.40	1.00	.50	2.00	1.30	.65	.60	.75
185 sq. yds. block pavem't, inc. concrete found	.400	3.00	4.00	4.00	3.00	4.00	4.50	4.00
200 sq. yds. bluestone flag, to furnish & set in hydrant vaults	4.00	4.00	2.50	2.00	2.10	2.75	2.50	5.00
100 sq. yds. bluestone flag, inc. found	7.20	3.00	2.50	1.00	1.05	.75	.60	.70
1,300 lin. ft. stone curbing, inc. found	1.50	.02	1.00	.25	.20	.20	.10	.30
400 lin. ft. of granolithic curb, inc. found	1.30	.60	1.25	.75	1.00	.40	.40	1.10
5 M. ft. lumber, left in trench	100.00	.30	.40	.50	.40	.50	.50	.50
3,500 lin. ft. 6-in. vitr. tile drain pipe	.80	.50	.50	.40	.40	.50	.50	.30

** Items marked thus give the names of parties awarded contracts.*

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Bessemer, Ala.—The City Council is reported to have authorized the Mayor to borrow $15,000 for the construction of a sewer on 2nd Ave.

Douglas, Ariz.—Albert M. Sames, City Clk., writes that Frank H. Olmsted, of Los Angeles, Cal., has prepared plans and estimates for a sewerage system to cost about $65,000. An election will soon be called to vote on issuing the bonds for same.

Lincoln, Cal.—It is reported that the question of issuing bonds for a sewerage system will probably be submitted to a vote of the citizens.

Fresno, Cal.—Sewer bonds to the amount of $175,000 and $75,000 City Hall bonds were sold on Dec. 18. Geo. L. Hoxie, City Engr.

Colorado Springs, Colo.—City Engr. R. H. Ashworth is reported to be preparing estimates for sewer extensions for the coming year. About $11,000 will be expended.

Pensacola, Fla.—T. Chalkley Hatton, of Wilmington, Del., has been selected as Consulting Engr. for the proposed new sewerage system. J. N. Hazlehurst, Ch. Engr. of Mobile, Ala., has been selected to have charge of the proposed improvements to be made in this city, at a cost of $750,000.

South Bend, Ind.—The following are the totals of bids opened Dec. 20 by the Bd. of Pub. Wks. for constructing 2,434 ft. 66 in. trunk sewer: (*a*) Monolith concrete (reinforced); (*b*) Parmley reinforced concrete block (patented); (*c*) Jackson reinforced concrete sewer pipe (patent); (*d*) circular brick: Hoban & Roach, South Bend, *a* $24,045; *b*, $22,707; *c*, $25,262; *d*, $24,554. Jas. Nelson, South Bend, *b*, $26,544; *c*, $26,373; *d*, $26,909. F. G. Mortimer, Chicago, Ill., *c*, $26,904. L. H. Webster, South Bend, *a*, $24,998; *b*, $16,140; *c*, $21,565; *d*, $23,610. Keogan Constr. Co., South Bend, *a* $29,975; *b* $30,052; *c*, $30,117; *d*, $31,452.

Jeffersonville, Ind.—The Bd. of Public Wks. is reported to be considering the construction of a complete sewerage system. V. W. Lyon, City Engr.

Muskogee, Ind. Ter.—See "Water."

Chickasha, Ind. Ter.—See "Water."

Okmulgee, Ind. Ter.—See "Water."

Burt, Ia.—See "Water."

Storm Lake, Ia.—The Iowa Eng. Co., of Clinton, will prepare plans for a sewerage system.

**Independence, Kan.*—J. S. Barnwell, City Engr., writes that the following are the bids opened by City Council on Dec. 19 for (*a*) R. R. St. sewer, 2,400 ft. 18 in.; (*b*) Washington St. sewer, 900 ft. 10 in.: N. S. Sherman Machinery Co., Oklahoma City, Okla. (awarded contract, *a* $4,777; *b* $477; A. P. Robson, Pittsburg, Kan., *a* $4,999, *b* $599; Whitman & Woods, Independence, Kan., *a* $5,200, *b* $490..

Harper, Kan.—Plans and specifications are reported to have been adopted for new sewers.

Louisville, Ky.—Mayor Barth is reported to be in favor of employing expert sanitary engineers to make surveys and plans for a complete system of sewers for Louisville.

**Dorchester, Boston, Mass.*—D. F. O'Connell, of Dorchester, has secured the contract for constructing the Dorchester Brook sewer 5 ft. 7 in. by 8 ft., bids for which were opened on Dec. 18 at Boston, for $30,974. The other bids received were: Jas. D. Fallon, $32,218; W. B. Bryne, Medford, $33,274; Geo. Bryne, $36,209; W. J. Barry, $37,878; Patrick McGovern, $39,242; D. Lynch, $39,849; D. E. Coleman, $43,748; T. J. O'Connell, $41,634; Coleman Bros., $53,803, and P. W. Hill, $43,803. Bidders of Boston, unless otherwise mentioned.

St. Paul, Minn.—The Bd. of Pub. Wks. has reported favorably on the construction of sewers in Thomas, Chatsworth and Charles Sts., at a cost of $28,587.

Morris, Minn.—The question of constructing a sewerage system is reported under consideration here. C. B. Burpee, City Clk.

Kirksville, Mo.—An election will be held in January to vote on issuing $40,000 bonds, to be used for the construction of a public sewerage system and septic tank purification and disposal works, according to plans prepared by Stephen Hall, City Engr.

Paterson, N. J.—At a meeting of the joint sewage investigating committee on Dec. 27 it was voted to recommend to the Bd. of Aldermen the appointment of Allen Hazen, of New York, N. Y., as an assistant consulting engineer in the work of ascertaining the best and most economical method for disposal of the sewage of the city.

Newark, N. J.—Morris R. Sherrerd, Ch. Engr. and City Surveyor, suggested to the Bd. of Wks. on Dec. 21 that a bill be prepared and introduced at the coming session of Legislature empowering Newark to construct a sewer system in Newfoundland to protect the city's water supply from possible pollution. Surveys for such a system and tentative plans were prepared about a year ago. Mr. Sherrerd estimates that the cost of the proposed system, which is to include a disposal plant, would be about $75,000.

New York, N. Y.—Bids will be received until Jan. 9 by Louis F. Haffen, Pres. Boro. Bronx, for constructing sewers and appurtenances in numerous streets. Engineer's estimate: 3,345 lin. ft. concrete sewer, 2 ft. 6 in.; 42 lin. ft. 30-in., 2,503 lin. ft. 12-in., 4,648 15-in., and 10,443 12-in. pipe sewer; 41,362 lin. ft. brick sewer, 2 ft. 6 in.; 214 manholes; 50 receiving basins complete; 18,680 cu. yds. rock to be excav. and removed; 2,868 spurs for house connections over and above the cost per lin. ft. of sewer; 7,490 lbs. steel for I beams, in place as shown on plan; 1,175 cu. yds. concrete in place as shown on plan, excepting concrete cradle for pipe sewers and culverts; 173 M. ft. B. M. timber for foundations, furnished and laid, and sheeting furnished and left in place, etc.; also constructing receiving basins and appurtenances in numerous streets. Engineer's estimate: 690 lin. ft. 12-in. pipe culvert, 32 receiving basins; 3 M. ft. B. M. timber for foundations, furnished and laid, and sheeting furnished and left in place, etc.

Dayton, O.—Plans are reported to have been completed for the construction of new storm water sewers for the southeastern section of the city. F. W. Turner, City Engr.

Columbus, O.—The State Board of Health, Business Men's Organization and City Health Board, are reported to have decided to petition the Legislature to install a sewage purification plant at the State Girls' Industrial Home; estimated cost $12,000.

**Columbus, O.*—The following are the bids opened on Dec. 13 by the Bd. of Pub. Service (Julian Griggs, Ch. Engr.) for the construction of a sanitary sewerage system in Davis Ave., McDowell and Broad Sts. and Sullivan Ave. (*a*) Westwater & Casey, Columbus, $17,523; (*b*) C. T. McCracken & Co., Columbus, $16,942 (awarded contract).

	a	*b
13019 lin. ft. 8-in. sewer	$ 0.90	$ 0.92
3430 lin. ft. ¾-in. G. I. water pipe	0.30	0.30
390 lin. ft. brick repaving	0.40	0.40
48 manholes	35.00	35.00
18 single flush tanks	110.00	100.00
1 double flush tanks	120.00	110.00
19 meter boxes	10.00	10.00

Cleveland, O.—Bids will be received until Jan. 2 by the Bd. Pub. Service (A. R. Callow, Secy.) for constructing sewers in 12 streets; also Jan. 9 on 10 streets.

The following are the bids opened on Dec. 14 by the Bd. of Pub Service for constructing a sewer in Quimby St. from Willson Ave. to Norwood St. (*a*) 1,675 lin. ft. 6 ft. 6 in. circular brick concrete steel sewer, per lin. ft.; (*b*) 200 M. ft. plank and timber left in trench, per M. ft.; (*c*) totals including appurtenances. Beers & Doolittle, Citizens Bldg., *a*, $14.98; *b*, $18; *c*, $31,200. Jas. Duff Constr. Co., *a* $20.65; *b*, $18; *c*, $41,211. H. F. Helm, *a*, $21.65; *b*, $17; *c* $34,954. H. P. Burnett, *a*, $17.70; *b*, $17.50; *c*, $35,036. Chris. Burkhardt, *a*, $18.11; *b*, $16.50; *c*, $33,873. John H. Wagner, *a*, $17.98; *b*, $13.50; *c*, $31,200. J. Connelly Constr. Co., *a*, $15.80; *b*, $16.50; *c*, $31,685. Wm. Lehman, *a*, $19.10; *b*, $13.50; *c*, $36,411. Clements Bros. Constr. Co., *a*, $19.30; *b*, $20; *c*, $38,743. W. J. Townsend Co., *a*, $15.80; *b*, $16; *c* $31,395. Northern Ohio Paving & Constr. Co.; *a*, $19.17; *b*, $16; *c*, $37,253.

Clinton, O.—F. E. Myers, City Engr., writes that it is proposed to construct a storm sewer, either of brick or concrete. Estimates have not been completed.

Oklahoma City, Okla.—See "Water."

Erie, Pa.—The Council on Dec. 18 passed the ordinance providing for the construction of a sewerage system in the 6th Ward.

Salt Lake City, Utah.—Bids will be received until Jan. 4 by the Bd. Pub. Wks. (E. A. Wall, Chmn.) for furnishing material and constructing a storm sewer in 9th S St. Approximate quantities: 50 lin. ft. 33x36-in., 100 lin. ft. 33x42-in., 1,200 lin. ft. 36x54-in., and 1,200 lin. ft., 48x54-in. concrete sewer; 1,000 lbs. setting iron and steel; 50,000 lbs. setting steel reinforcement; 8 M. ft. B. M. wooden flume; 4,000 cu. yds. earth excav. for sewer; 7,600 cu. yds. earth embankment in old canal. Geo. W. Riter, City Engr.

**Seattle, Wash.*—Contracts for sewer work have been awarded as follows: King and Weller Sts., to D. Dow & Co., $9,733; Jackson St., Stirrat & Goetz, $5,305, and Main St. sewer, T. I. Peterson, $5,210.

**Fredericton, N. B.*—Local press reports state that the following are the bids opened on Dec. 21 for the construction of a sewerage system, including 51,000 cu. yds. trench excav.; 58,000 lin. ft. pipe laying, 8 to 18 in. diam., and 630 cu. yds. brick masonry: J. B. McManus Co., Memramcook, $42,013 (awarded contract): Geo. M. Bryne Co., Boston, Mass., $52,460; Bruno Bros. & McKenzie, Boston, Mass., $53,327; Gow Palmer & Co., Boston, Mass., $53,822; Willard Kitchen, Fredericton, $58,012; Brown Bros., Fredericton, $58,708; B. Mooney & Sons, St. John, $60,995; Reid McManus, Memramcook, $74,165. Pipes and material are to be supplied by the city. Engineer Barbour, of Boston, Mass., will have charge of the construction work.

Guantanamo, Cuba.—Bids will be received at the Bureau Supplies and Accounts, Navy Dept., Washington, D. C., until Jan. 16, to furnish at the naval station, Guantanamo Bay, a quantity of iron pipe and fittings, vitrified sewer and fittings, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

BRIDGES.

Notes Arranged Alphabetically by States.

**Little Rock, Ark.*—The Bd. of Pub. Affairs is stated to have awarded the contract for constructing the steel viaduct over the railroad tracks at Ft. Smith Crossing to the Texas Bridge Co., of Dallas, Tex., who submitted 3 bids, as follows, $40,138, $39,000 and $37,666. Other bids received were Missouri Bridge Co., $50,000; Virginia Bridge & Iron Co., $47,703; M. S. Hasie, Jr., $46,100, and the Midland Bridge Co., $49,000.

New Haven, Conn.—See "Paving and Roadmaking."

Cameron, Ill.—Bids will be received until Jan. 15 by the Rock Island Southern R. R. Co., Monmouth, Ill., for constructing a girder bridge.

Vincennes, Ind.—It is stated that bids will be received until Jan. 3 by John T. Scott, Co. Aud., for constructing 4 steel bridges, one steel approach and the removal of a high truss bridge and a 180-ft. steel approach. E. C. Williams, Ch. Engr.

Indianapolis, Ind.—Bids will be received until Feb. 3 by Cyrus J. Clark, Co. Aud., for $170,000 bridge bonds.

Haverhill, Mass.—Bids will be received by the Comrs. of Essex County at Salem, on Jan. 19 for the constructing the substructure also the superstructure of a 5-span steel bridge over Merrimac River at Haverhill, both advertised in The Engineering Record.

Minneapolis, Minn.—Bids will be received until Jan. 15 by the Bd. Co. Comrs. for repairing and rebuilding several bridges throughout the county. Hugh R. Scott, Co. Aud.

Lexington, Neb.—It is stated that bids will be received until Jan. 10 by R. S. Thornton, Co. Clk., for constructing all the County bridges that may be needed during 1906.

**Perth Amboy, N. J.*—The New York & Long Branch R. R. Co. is reported to have awarded contracts for constructing an iron drawbridge over Raritan River, between Perth Amboy and South Amboy, as follows: Sub-structure, to McMullen & McDermott, of Philadelphia, Pa., for about $500,000; metal work, including the draw and machinery, to the Pennsylvania Steel Co., of Philadelphia, Pa., for about $425,000. The new bridge will be equipped with double tracks, and will consist of 17 deck plate girder spans on masonry piers.

**Portland, Ore.*—A contract is stated to have been let to the American Bridge Co. by the Oregon R. R. & Navigation Co. (M. J. Buckley, Gen. Supt.) for construction of a heavy steel bridge over the Clearwater River. The structure will be 1,240 ft. long, including trestle approach, and will cost $190,000.

**Oakville, Pa.*—The County Comrs. are stated to have opened bids as follows for constructing a bridge over Loyalhanna Creek at Oakville: American Bridge Co. of New York, N. Y., $19,985 (awarded contract); Penn Bridge Co. of Beaver Falls, $23,580, and the York Bridge Co. of York, $25,000. The structure to be 220 ft. long, consisting of 2 spans each 110 ft. long with stone abutments and piers, steel superstructure and concrete floors.

Nashville, Tenn.—The County Comrs. are reported to have under discussion the location of a bridge across Cumberland River.

Norfolk, Va.—It is stated that the Norfolk & Western R. R. Co. (C. S. Churchill, Ch. Engr., Roanoke) has plans prepared for double track bridges across the Southern and Eastern branches of Elizabeth River.

Scottsville, Va.—Jos. P. Blair, City Clk., writes that it is proposed to construct a bridge over James River, at a cost of $18,000. No engineer selected as yet.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

New Haven, Conn.—City Engineer Kelly is stated to have estimated the cost of extending Humphrey St. to Allen St. as follows: straightening Mill River, $12,000; filling in necessary, $30,000, and for the railroad bridge over the new street, $20,000.

**Kalamazoo, Mich.*—Contracts for paving (bids opened Dec. 18) have been awarded as follows: to the Barber Asphalt Paving Co., Detroit, for paving Rose St., 10,000 sq. yds., with sheet asphalt. This company bid for the city portion, $1.86½, for Trinidad Pitch Lake, and $1.74 for Solidad, and for the St. Ry. portion, $1.87½ and $1.74 per sq. yd. respectively. Roy Williams, of Connersville, secured the contract for paving Edwards St. and Michigan Ave., about 15,000 sq. yds., with Metropolitan block, pioneer filler, at $1.82 per sq. yd. M. C. Taft, City Engr.

**Jackson, Mich.*—Geo. H. Kneal is stated to have received the contract for paving with brick on Elizabeth and 1st Sts., Park and Michigan Aves., for about $10,000.

St. Paul, Minn.—Bids will be received until Jan. 2 by the Bd. Pub. Wks. (R. L. Gorman, Clk.) for paving a portion of E. 5th St., with sand-lime brick (patented).

Vicksburg, Miss.—The paving of Washington St. is reported under consideration.

**Avalon, N. J.*—Geo. W. Kales, Chmn. Paving Com. Boro. Council, writes that contracts for paving (bids opened Dec. 21) have been awarded as follows: Contract 10, to B. F. Sweeten, Camden, for 40-ft. roadway, $1.42 per lin. ft.; 50-ft. roadway, $1.85, and for curb, 37 cts. Contract 11 to Jas. McLendon, of Anglesea, 40-ft. roadway $1.31 per lin. ft.; curb, 35 cts., and Contract 12 to H. H. Holmes, of Peermont, Avalon, 40-ft. roadway, $1.50; 50-ft., $2.25; 100-ft., $3.25, and curb, 37½ cts.

Jersey City, N. J.—Bids will be received until Jan. 8 by the Bd. Street and Water Comrs. (Geo. T. Bouton, Clk.) for improving a portion of Wilkinson Ave. Approximate estimate of quantities: 10,584 sq. ft. flagging; 2,700 lin. ft. curb., 5 x 16 in., set in concrete; 882 sq. yd. Belgian paving, in gutters; 2,995 cu. yd. earth filling; 3,591 cu. yd. earth excav., etc.

New York, N. Y.—Bids will be received until Jan. 9 by Louis F. Haffen, Pres. Boro. Bronx, for paving with asphalt, on a concrete foundation, a portion of Hewitt Pl. Engineer's estimate: 2,260 sq. yds. completed asphalt pavement, including binder course, and keeping the pavement in repair for 5 years from date of acceptance 385 cu. yds. concrete; 1,120 lin. ft. new curb, furnished and set in concrete; also grading, curbing and flagging the sidewalks on Fox St., Cypress and Devoe Aves. Engineer's estimate: 15,275 sq. ft. new flagging, furnished and laid; 3,875 lin. ft. new curb, furnished and set; 5,350 cu. yds. filling; 1,650 cu. yds. earth excav., etc.

Cobleskill, N. Y.—The proposed paving for which the citizens recently voted $55,000 bonds, will be of vitrified brick on crushed stone foundation. W. H. Golding, Town Clk.

Chatham, N. Y.—The Bd. of Supervisors is stated to have passed a resolution providing for the construction of a State road 3¼ miles long, extending from Chatham to Spencertown.

Rochester, N. Y.—An ordinance providing for the paving of East Ave. is reported to have been adopted by the Common Council. The Bd. of Contract was directed to receive bids for Medina and asphalt block. Other ordinances passed are reported as follows: paving portion of Cortland St. at an estimated cost of $20,000, also for extending Lewis and Hempel Sts.

Brooklyn, N. Y.—The Com. on Finance is stated to have passed the ordinance providing for the issue of $1,875,000 Corporate Stock for the completion of the Shore Rd. between 1st Ave. and Ft. Hamilton, Boro. of Brooklyn.

The following are the bids opened Dec. 27 by Martin W. Littleton, Pres. Brooklyn Boro., for regulating and paving with asphalt, on a concrete foundation, Pitkin Ave. from Linwood St. to Lincoln Ave.: (*a*) 19,490 sq. yds. asphalt; (*b*) 2,705 cu. yds. concrete; (*c*) totals: Brooklyn Alcatraz Co., 12th St. and Gowanus Canal, Brooklyn, *a* 75 cts.; *b* $4.75, *c* $27,466; Cranford Co., 52 9th St., Brooklyn, *a* $1, *b* $5, *c* $33,015; Uvalde Asphalt Paving Co., 1 Bway., N. Y., *a* 85 cts., *b* $5, *c* $30,091; Barber Asphalt Paving Co., 114 Liberty St., N. Y. City, *a* 96½ cts., *b* $3.96, *c* $29,520.

Canajoharie, N. Y.—The Bd. of Supervisors is stated to have approved of the following State roads. One is from the corporation line of Nelliston easterly along the turnpike to the corporation line of Palatine Bridge, and from Palatine northerly to Stone Arabia Corners, a distance of 3.93 miles. The estimated cost is $34,100, of which the county's share will be $17,050.

The other road is from Herkimer County line at East Creek to the corporation limits of St. Johnsville, and from the easterly line of that village to a point near the Palatine Church, or the boundary between the towns of St. Johnsville and Palatine, being a distance of 5.62 miles. The estimated cost is $57,500, and the county's share will be $28,750.

Syracuse, N. Y.—It is stated that the Bd. of Contract and Supply rejected all bids received Dec. 18 for paving Leavenworth Ave., Tully St. and Highland Ave. According to reports new bids will be received.

** Items marked thus give the names of parties awarded contracts.*

Sherman, Tex.—Chas. E. Hayden, City Engr., writes that the following are the bids opened Dec. 18 for paving: (*a*) Chas. T. Derr, Guthrie, Okla.; (*b*) C. E. Hall, Clinton, Mo.; (*c*) R. K. Dabney, Grandprairie (awarded contract):

	a	*b*	**c*
4,118 sq. yds. brick on 4-in. concrete, 2-in. sand foundation	$1.75	$1.70½	$1.65½
10,172 sq. yds. brick on 5-in. concrete, 2-in. sand foundation	1.88½	1.84	1.78
4,145 lin. ft. rock curb, 6 x 18 in.	.70	.75	.55
413 lin. ft. 3 x 12 in. wood headers	.10	.08	.08

Rockingham, N. C.—Bids will be received until Feb. 5 by the Comrs. (H. S. Ledbetter, Chmn.) for $15,000 Rockingham Township Good Road Bonds.

Cleveland, O.—Bids will be received until Jan. 13 by the Bd. Co. Comrs. (Julius C. Dorn, Clk.) for grading, draining and paving a portion of Miles Ave. Wm. H. Evers, Engr., 237 The Arcade.

Cincinnati, O.—Bids will be received until Jan. 19 by the Bd. Co. Comrs., for improving Grove Ave., Springfield Township. C. C. Richardson, Co. Aud.

Bucyrus, O.—The City Auditor writes that it is proposed to pave Lucas St. with vitrified brick, at a cost of $18,500.

Akron, O.—City Engineer Payne is stated to have submitted estimates on the paving of a portion of Sherman St. as follows: block asphalt, $38,604, and with brick, $22,902.

Chattanooga, Tenn.—Bids will be received until Jan. 2 by the Bd. Pub. Wks. (A. L. Thomas, Chmn.) for paving portions of Boyce and Cherry Sts. with vitrified brick, also repaving a portion of 7th St. wtih vitrified brick. Robt. Hooke, City Engr.

Norfolk, Va.—The Council is stated to have decided to appropriate $21,000 for improving Redgate Ave.

Georgetown, Wash.—It is stated that the council passed an ordinance providing for the expenditure of $19,000 for street improvements.

**Tacoma, Wash.*—The contract for grading and laying sidewalks and gutters on a portion of S. Washington St. is stated to have been awarded to Gabriel Wallace, for $3,851.

The City Council is stated to have passed a resolution providing for the paving of a portion of Commerce St. with asphalt and the intersecting streets from Pacific Ave. to C St. with sandstone.

**Seattle, Wash.*—The following are the bids recently received for paving 14th Ave. and other streets with asphalt: (*a*) Barber Asphalt Paving Co., $30,257; (*b*) Independent Asphalt Paving Co., $27,731 (awarded contract).

	a	**b*
Fixed estimate	$2,000.00	$2,000.00
Clearing and grubbing	150.00	50.00
3,500 cu. yds. sub-grading	.35	.05
130 lin. ft. 8-in. pipe sewer	1.00	.90
625 lin. ft. curved granite curb	1.25	1.15
8,100 lin. ft. concrete curb	.30	.27
90 sq. yds. concrete	1.00	.95
11,450 sq. yds. asphalt pavement	1.70	1.64
150 sq. yds. concrete alley crossings	1.00	1.20
1,450 sq. yds. brick gutters	2.40	2.15
10 catch basins, reconstructed	10.00	8.00

Fond du Lac, Wis.—The Council is reported to have under consideration the paving of 4th St.

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Douglas, Ariz.—Albert M. Sames, City Clk., writes that E. Titcomb, of Nogales, and W. Hamaker, of Douglas, have secured a franchise for a gas plant, the plant proposed will cost about $50,000.

Argenta, Ark.—Bids will be received by C. J. Humphreys, Secy. Bd. of Improv. Dist. No. 1, Argenta, until Jan. 15, for the purchase of all material required for the construction of water works and electric light plant, as advertised in The Engineering Record.

Napa, Cal.—Attorney Raymond Benjamin, of Napa, is reported to have petitioned the Bd. of Supervisors of Napa County, for a franchise for a light and power plant. A company is reported as being organized by J. S. McDonald, of San Francisco, to generate power at Napa, and supply electricity to Oakville, Younteville, Rutherford, St. Helena, Calistoga and Napa. It is reported that bids for said franchise will be received by W. N. Collin, Clk. Bd. Superv., until Jan. 12.

Los Angeles, Cal.—Bids will be received until Jan. 5 by the Bd. Educ. (N. S. Averill, Secy.) for the switchboard and electrical indicating instrument for the new Polytechnic High School.

San Francisco, Cal.—The Stanislaus Electric Power Co. is reported incorporated at Hartford, Conn., with a capital of $10,000,000, to operate in the State of California. John C. Rice, of Boston, Mass. Arthur Perkins, of Hartford. Conn., and Robt. J. Richardson, of Brookline, Mass., are among the incorporators.

Fresno, Cal.—A. G. Wishon, of Fresno, Gen. Mgr. San Joaquin Light & Power Co., writes that it is proposed to construct a transmission line with hydraulic generating plants at a cost of about $1,000,000. It will not be built by contract. Engineer, D. L. Wishon, of Visalia.

Georgetown, Colo.—E. J. Wilcox, of Denver, chief promoter of the Waldorf Mining Co., writes that bids for construction work in connection with the proposed power development will be received about Apr. 15.

Washington, D. C.—Bids will be received until Jan. 23 at the Bureau Supplies and Accounts, Navy Dept., Washington, D. C., to furnish at the navy yards, Mare Island, Cal., and Puget Sound, Wash., a quantity of naval supplies, as follows: Schedule 300: Conduit and fittings; motor-drive outfits, etc. Schedule 301: Iron; triplex blocks; tool and bar steel, etc. H. T. B. Harris, Paymaster-Gen., U. S. N.

Atlanta, Ga.—The ordinance granting franchises to the Southern Light & Power Co. to do an electric lighting and power business in Atlanta was adopted on Dec. 22 by the Bd. of Aldermen and the Common Council.

Aurora, Ind.—The Indiana Public Service Co. is reported incorporated, to construct a light and heating plant. David J. Hauss, Pres.

Osawatomie, Kan.—W. H. Murphy, Supt. Osawatomie Electric Light & Power Co., writes that bids will be received about Apr. 1 for the construction of an electric light plant, at a cost of $10,000. The company will add an ice plant later on.

Dexter, Me.—Press reports state that N. Curtis Fletcher, of Boston, Mass., the new owner of the plant of the Dexter Electric Light & Power Co., will shortly commence the construction of a new power plant.

Taneytown, Md.—A charter has been granted to Edw. E. Reindollar, D. J. Hesson, Jos. E. Roelkey, and others, to construct an electric light plant here. If franchise is secured it is proposed to construct a plant at a cost of from $8,000 to $10,000. A 100-h.-p. engine, 125-h.-p. boiler and 1,000-light dynamo will be installed.

St. Cloud, Minn.—A. G. Whitney, of St. Cloud, writes that the Public Service Co. will construct a gas plant at a cost of $65,000.

Minneapolis, Minn.—City Engr. Andrew Rinker is stated to have been requested to investigate the matter of utilizing the water power at the falls of St. Anthony, the power to be used for lighting the city hall and other public buildings.

St. Paul, Minn.—The West Side Power, Heat & Light Co. is reported incorporated, with a capital of $50,000, to construct a plant of 2,000 or 3,000 h.-p., to supply some of the manufacturing plants on the west side with electric light and power. Incorporators: A. B. Stickney, Oliver Crosby and G. F. Philleo.

*The St. Paul Gas Light Co. is reported to have secured the contract for maintaining 519 overhead electric lamps at $90 per light per year and for each additional lamp $8 per month. This company also secured contract for the gas lighting. The Patterson St. Lighting Co. secured the contract for the gasoline lighting at $24.96 per lamp per yr.

New Albany, Miss.—The citizens are reported to have voted to issue $9,000 bonds for extending the electric light plant.

St. Louis, Mo.—Chas. Ware, Geo. Kingsland and Thos. C. Henning are reported to have petitioned the House of Delegates for permission to construct a heating and lighting plant in Maplewood near the city limits.

Sam'l Bowman is chairman of the committee appointed by F. G. Zerbig, Pres. Real Estate Exchange, to urge the establishment of a municipal lighting plant, for the better illumination of the streets in the business section of the city.

Missoula, Mont.—The citizens are reported to have voted on Dec. 18 to grant Dr. Jos. Oettinger a franchise to construct and maintain a gas plant. The plant will, it is said, cost about $100,000, with $50,000 additional for mains.

Kearney, Neb.—S. J. Duncan, of Kearney, Supt. Northwestern Electric Heat & Power Co., writes that it is proposed to install a new boiler and Corliss engine in the spring. Owner, Wm. E. McCully, of Macon, Mo.

**New York, N. Y.*—L. Plaut & Co., 432 E. 23d St., has secured the contract for lighting fixtures for the 71st Regt. Armory (bids opened Nov. 28) for $15,887.

Endicott, N. Y.—L. L. Rose, of Endicott, is reported interested in the construction of a gas plant to supply Endicott and Union with gas, at a cost of $75,000.

Palmyra, N. Y.—The Niagara, Ontario & Lockport Power Co. (E. D. Beal, Attorney, Rochester) is reported to have secured a franchise.

Henrietta, N. Y.—The Niagara, Lockport & Ontario Power Co. (E. D. Beal, Attorney, Rochester) is reported to have purchased property in Henrietta, to be used as a site for a sub-station or transformer station.

Charlotte, N. C.—The Southern Power Co. is reported to have purchased about 5 miles of water front along Broad River, in Cherokee County, and will add to its development about 12,000 h.-p., at a cost of about $1,000,000.

Gaffney, N. C.—The Southern Power Co., Trust Bldg., Charlotte, is reported to have purchased a water power, located on Broad River, in Cherokee County, between Gaffney and Blacksburg, and will expend about $1,000,000 in its development.

Langdon, N. D.—Liebeler & Finnerty are reported to have purchased the electric light plant, and will make improvements, including the purchase of a boiler.

Minto, N. D.—There is some talk of constructing a gas plant here.

Grand Forks, N. D.—The Grand Forks Gas & Electric Co. (W. J. Murphy, Gen. Mgr.,) is reported to have decided to erect a new power house.

Lima, O.—J. W. Halfhill, of Lima, and H. L. Canfield, of Delphos, are reported to have petitioned for a franchise for an electric light plant.

Xenia, O.—The City Council is reported to have granted the Citizens Light & Power Co. a franchise to furnish light and power to the city.

Watonga, Okla.—G. E. Moore, Town Clk., writes that it is proposed to extend the water mains at a cost of $10,000, and construct an electric light plant at a cost of $6,000. No plans prepared as yet.

Ashland, Ore.—The Ashland Electric Light & Power Co. is reported to have offered to sell its plant and franchises to the city of Ashland.

Drain, Ore.—The Drain Water, Light & Power Co. is reported incorporation with a capital of $5,000, by Ira Wimberly, Benton Mires, and others. The company proposes constructing water works and later on an electric light plant.

Heppner, Ore.—The citizens are reported to be discussing the question of water and light.

Silverton, Ore.—The Citizens Light & Traction Co., of Salem (A. Welch, Mgr., Salem), is reported to have purchased the plant of the Union Light & Power Co., of Silverton, and will rebuild dam and develop all power possible.

Salisbury, Pa.—The Citizens' Light, Heat & Power Co. is reported incorporated, with a capital of $10,000, by John Meager, H. H. Maust, Richard E. Newman, and others.

**Providence, R. I.*—The Narragansett Electric Lighting Co. has secured the contract for lighting the city for 6 yrs., the first 3 yrs. at $104.75 per lamp per yr., and the next 3 yrs. at $100 per light per yr.

Florence, S. C.—Engineers Ladshaw & Ladshaw, of Spartanburg, write that bids will probably be received about Feb. 1 for the development of the power of Black Creek, near Florence, for the Florence Light & Power Co.; probable cost of work, $150,000.

Aberdeen, S. D.—The engineer has not yet been selected for the proposed municipal electric light plant. D. C. Washburn, City Engr.

Trezevant, Tenn.—The question of constructing water works and an electric light plant is reported under consideration.

Ogden, Utah.—L. B. Spencer, 203 Eccles Bldg., Ogden, Consulting Engr. for the South Fork Power & Irrigation Co., writes that it is proposed to construct reservoir, dam and power house, at a cost of about $500,000. Preliminary work not yet complete. The bed rock exploration for dam site has not been finished yet. Work has been stopped on account of weather, but will be resumed in the early spring.

Beaver, Utah.—Lucien L. Nunn, of Provo, is reported to have filed an application for 40-second-feet of water, to be diverted from Beaver River. If granted he will establish a plant at Beaver to furnish heat, light and motive power at Beaver, Milford, Frisco and Newhouse and mines in Gold Mountain, Mt. Nebo, Ohio and Maryvale mining districts.

Provo, Utah.—Bids will probably not be called for before the spring for the construction of the proposed water works and electric light plant. Engineer, Frank C. Kelsey, of Salt Lake City.

Spokane, Wash.—Lewis Larson is reported to have petitioned Council for a gas franchise.

Port Townsend, Wash.—H. M. Bennett and A. E. Sims are reported to have petitioned for a franchise for an electric light plant.

Seattle, Wash.—The Seattle-Tacoma Power Co. (O. D. Colvin, Mgr., Seattle,) is reported to be preparing to build a transmission line from Snoqualmie Falls, down the river to Everett.

South Bend, Wash.—J. M. Etnier is reported to have assigned his electric light franchise to M. C. Walsh, who, it is stated, will form a company to construct electric light plant to furnish South Bend and Raymond with electricity.

Kaukauna, Wis.—The Kaukauna Electric Light Co. is reported to have decided to purchase a 150-h.p. generator.

Stoughton, Wis.—A company is reported to have been formed here, by A. E. Smith and W. B. Jackson, to establish a gas plant to cost about $30,000.

Beloit, Wis.—Chas. F. Pfister and Wm. Bigelow, of Milwaukee, and E. G. Cowdery, of St. Louis, and others, of the Beloit Electric Co., are reported to have petitioned Council for a franchise for a gas plant.

**Toronto, Ont.*—The Toronto Electric Light Co. is reported to have secured the contract for lighting the city for 5 years at 19 cts. per light per night. The Carbon Light & Power Co. secured the contract for the gas lamps at $28.60 each per year.

Montreal, Que.—Prof. E. W. Bemis, of Cleveland, O., the gas expert employed by the City Council to prepare a report for a municipal gas plant for Montreal, estimates the cost as follows: mains, $1,721,516; meters and services, $904,500, and manufacturing plant and holders, $1,545,000, making the total cost of a plant to supply the immediate needs of the city with its suburbs at $4,171,000.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Mountain Home, Ark.—The Mountain Home & White River Traction Co. is reported incorporated to build an interurban railway. Capital $25,000. John J. Geghan, of Yellville, Pres.; W. L. Marshall, of Mountain Home, Vice-Pres.

Ft. Smith, Ark.—It is stated that the Ft. Smith Light & Traction Co. is to build a bridge across the Arkansas River, so as to extend its lines to Van Buren.

San Diego, Cal.—At a recent meeting of the Council an ordinance is stated to have been adopted accepting the bid of G. M. Hawley for the Adams Ave. franchise.

The resolution offering for sale the street railway franchise, petitioned for by P. B. Moore, which runs from 32d St. and National Ave. south to the National City boundary, is reported to have been adopted by Council.

San Francisco, Cal.—The Parkside Transit Co. is reported to have been incorporated for the purpose of constructing a railway, 5 miles long, for the recently laid out Parkside section of the city. Directors, Wm. H. Crocker, Douglas S. Watson and others. Capital $500,000.

City Engineer Thos. P. Woodward has made it necessary to rescind the measure calling for bids (which were to have been opened on Jan. 3) for the reconstruction of the Geary St. line by asking for the return of the plans and specifications recently presented by him to the Bd. of Supervisors. He states that several changes will have to be made in the wording of the specifications, as well as some alterations in the plans themselves.

San Francisco, Cal.—It is reported that the interests controlling the San Jose-Los Gatos Interurban Ry. will soon incorporate a new company for the purpose of building an electric road from San Jose and Los Gatos to San Mateo. The route of the proposed new road, it is understood, lies some little distance to the west of the Southern Pacific Company's tracks down the peninsula.

** Items marked thus give the names of parties awarded contracts.*